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Part 25
Airworthiness Standards: Transport Category Airplanes

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Adoption of Part 25

Adopted: November 3, 1964 **Effective: February 1, 1965**

(Published in 29 F.R. 18289, December 24, 1964)

This amendment adds Part 25 [New] to the Federal Aviation Regulations to replace Part 4b of the Civil Air Regulations, and is a part of the Agency recodification program announced in Draft Release 61-25, published in the Federal Register on November 15, 1961 (26 F.R. 10698).

Part 25 [New] was published as a notice of proposed rule making in the Federal Register on June 2, 1964 (29 F.R. 7169), and given further distribution as Notice No. 64-28.

During the life of the recodification project, Chapter I of Title 14 may contain more than one part bearing the same number. To differentiate between the two, the recodified parts, such as this one, are labeled "[New]". The label will be dropped at the completion of the project as all of the regulations will be new.

Many of the comments received recommended specific substantive changes to the regulations. Many of these recommendations appear to be meritorious. However, they cannot be adopted as a part of the recodification program, since the purpose of the program is simply to streamline and clarify present regulatory language and delete obsolete or redundant provisions. To attempt substantive changes, other than relaxatory ones that are completely noncontroversial, would delay the project and be contrary to the ground rules specified for it in Draft Release 61-25. However, all comments of this nature will be preserved and considered in any later substantive revision of this part.

Present CAR Part 4b reflects the various writing styles used by those who have worked on it in the past. The recodification has allowed us to use one style throughout Part 25 [New]. The style changes that have been made do not affect substance. They have been made to ensure consistency in language throughout the new Federal Aviation Regulations, thereby making them easier to understand and apply. Part 25 [New] substitutes the word "must" for "shall". This has been done to reflect the fact that airworthiness standards are simply conditions precedent that are required to be met for the issue of a type certificate. The imperative "shall" would be inappropriate in this case. The failure to meet the standards simply results in a denial of the issue of the type certificate.

The sections in Part 25 [New] have been rearranged and renumbered so that the requirements of this part have the same number as comparable requirements in Parts 23 [New], 27 [New], and 29 [New]. Where there is no comparable requirement in Part 25, there is a gap in the section numbering (in addition to gaps from the use of odd section numbers only and the "growth" gaps between subtopics). In addition, some material has been rearranged in order to more logically place some requirements within the part. An example of this was the grouping of the parts of §§ 4b.117, 4b.361, 4b.362, 4b.437, 4b.640, 4b.719, 4b.736, 4b.740 through 4b.743, and SR 422B sections 4T.123 and 4T.743, dealing with recording of information and data in the Airplane Flight Manual, into the Airplane Flight Manual subdivision of this part. A similar rearrangement was made by combining the flutter requirements of §§ 4b.190(a), 4b.210(c)(3), and 4b.308 into § 25.629 and vibration requirements of these same sections into § 25.251.

The most significant changes to Part 25 since the notice are listed below. The numbers in parentheses refer to the section number in the notice and in former Part 4b, respectively.

Section 25.1001 (§ 25.733) (§ 4b.437) has been revised by changing the requirement for a placard to warn flight crewmembers against jettisoning fuel with flaps lowered (if it has not been shown that it is safe to do so with them lowered). It now reads "means (including flaps, slots, and slats) for changing the airflow across or around the wing" instead of the word flaps. This was done to update the language as these other devices (slats and slots) take the place of the flaps in some airplanes and are referred to in other regulations (particularly in ADs).

In § 25.611 (§ 25.401) (§ 4b.305) "periodic inspection" has been replaced with "recurring inspection". This avoids any potential conflict between the intent of the subject section, to cover all inspections that occur at regular intervals, and the more specific use of the term "periodic inspection" in Parts 43 [New] and 91 [New].

In response to a comment, a cross reference to § 25.1145(b) has been added to § 25.1307 (§ 25.947) (§ 4b.605) to make it clear that a ganged ignition switch may be used to satisfy the subject requirement.

Other minor changes of a technical clarifying nature have been made. They are not substantive and do not impose any burden on regulated persons. For example, the Agency is standardizing the language used to describe an aircraft, with respect to the type of engine installed, as follows:

An aircraft powered by a reciprocating engine is a "reciprocating engine powered aircraft".

An aircraft powered by a turbine engine is a "turbine engine powered aircraft".

An aircraft powered by a particular subtype of turbine engine is a "turbopropeller powered aircraft" or "turbojet powered aircraft", whichever is appropriate.

In the notice, it was proposed to convert references to "miles" and "miles per hour" to their nautical equivalents. The only comment received was favorable. To make this part uniform and to conform to modern practice, "nautical miles" and "knots" have been used throughout. The associated values have been adjusted so that no increase in burden results.

This part incorporates Amendment 4b-15, Installation of Cockpit Voice Recorders, published in the FEDERAL REGISTER July 3, 1964, and Amendment 4b-16, Flutter Deformation and Vibration Requirements, published in the FEDERAL REGISTER on September 5, 1964

The definitions, abbreviations, and rules of construction contained in Part 1 [New] of the Federal Aviation Regulations apply to Part 25 [New].

When Part 1 [New] was adopted, its preamble stated that it would be amended as necessary in order to apply to specific regulations as they were recodified. As part of this action, Part 1 [New] is being amended to incorporate definitions and abbreviations found to be necessary because of the adoption of subsequently issued Federal Aviation Regulations, including Subchapter C.

The definition of "accelerate-stop distance" has been incorporated from Parts 4b, 40, 41, and 42, that of "critical altitude", from Parts 3, 4b, 6, 7, and 13, and that of "load factor", from Parts 3, 4b, 6, and 7. The definitions of "clearway" and "stopway" have been incorporated from Special Civil Air Regulations 422A and 422B and, as a result, § 91.37 is being amended to delete the definitions of "clearway" and "stopway" in paragraph (d). Also, since SRs 422A and 422B, together, set forth the certification procedures for all turbine engine powered airplanes certificated after September 30, 1958, the references to the two SRs in § 91.37 have been replaced by references to their respective periods of effectiveness.

In addition to these definitions, Part 1 [New] is being amended to correctly reflect the "½" in the definition of "true airspeed" as a power rather than as a multiplicand.

The abbreviations and symbols set forth below have been incorporated from Parts 3, 4b, 6, and 7.

The performance and Airplane Flight Manual requirements of SR 422B are in this part. The corresponding requirements of SRs 422 and 422A are being deleted as they may no longer be used for airplanes to be certificated under this part. They will have the same status as any superseded section of a current rule. The operating rules of SRs 422, 422A, and 422B where current, will be put in the Air Carrier Operating rules.

As CAR Part 4a, "Airplane Airworthiness" has not been used for certification of new airplanes since 1947, it is being deleted. This action is consistent with the recodification aim of eliminating obsolete or unnecessary provisions and is similar to the action taken with Part 33 of the Civil Air Regulations and Parts 450, 560, and 580 of the Regulations of the Administrator. CAR 4a will have the same status as any superseded section of a current rule.

Interested persons have been afforded an opportunity to participate in the making of this regulation and due consideration has been given to all relevant matter presented. The Agency is particularly appreciative of the cooperative spirit in which the public's comments were submitted.

In consideration of the foregoing, Chapter I of Title 14 is amended as follows, effective February 1, 1965.

1. By deleting items 1 and 2 of SR 422.
2. By deleting items 1, 2, and 5 of SR 422A.
3. By deleting items 1, 2, and 5 of SR 422B.
4. By deleting Part 4a "Airplane Airworthiness".
5. By deleting Part 4b "Airplane Airworthiness, Transport Category".
6. By adding a Part 25 [New] reading as hereinafter set forth.

AUTHORITY: The provisions of this Part 25 issued under secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, and 1423.

Amendment 25–1

Adopted: March 3, 1965 **Effective: June 7, 1965**

(Published in 30 F.R. 3200, March 9, 1965)

The purpose of these amendments is to provide for improved emergency evacuation procedures and equipment for passenger-carrying aircraft. These actions were proposed in Notice 63-42 (28 F.R. 11507) issued October 23, 1963, and they were the subject of a Public Hearing held June 25, 1964, pursuant to Notice published April 28, 1964 (29 F.R. 5640), after postponement from May 26, 1964.

The proposals concerned amendments to the following Civil Air Regulations: Part 4b—Airplane Airworthiness: Transport Categories; Part 40—Scheduled Interstate Air Carrier Certification and Operations Rules; Part 41—Certification and Operations Rules for Certificated Route Air Carriers Engaging in Overseas and Foreign Air Transportation and Air Transportation within Hawaii and Alaska; and Revised Part 42—Aircraft Certification and Operation Rules for Supplemental Air Carriers, Commercial Operators Using Large Aircraft, and Certificated Route Air Carriers Engaging in Charter Flights or Other Special Services.

The proposals as discussed at the Public Hearing were changed in some details from those published in Notice 63-42, after study of the comments received in response to that Notice, and further analysis of the problems involved. They also were changed in some minor details after study of the presentations made at the Public Hearing.

The amendments do the following:

(1) Require air carriers and commercial operators using large aircraft to physically demonstrate the adequacy of procedures established for passenger emergency evacuation on each type and model of airplane used in passenger-carrying operations that has a seating capacity of over 44 passengers.

(2) Require one portable battery-powered megaphone as emergency equipment on each passenger-carrying airplane with a seating capacity of more than 60 passengers (two megaphones if the seating capacity is more than 99 passengers).

(3) Make uniform the provisions for briefing of passengers, for flight attendants, and for assignment of emergency evacuation functions for categories of crewmembers, with respect to rules formerly in Parts 40 and 41, and Revised Part 42.

(4) Introduce required oral briefing of passengers on the location and operation of emergency exits, on passenger-carry-

ing airplanes.

(5) Require flight attendants, on passenger-carrying airplanes with seating capacity of more than nine, varied in number up to at least four for airplanes with seating capacity of more than 149.

(6) Revise provisions on assignment of emergency evacuation functions for crewmembers.

(7) Prescribe revised and new standards for emergency exit locating signs and exit-opening instructions, exterior marking of these exits, emergency cabin illumination in a crash landing or upon interruption of the airplane's normal electrical power, strength requirements for latches designed to keep certain doors open during takeoffs and landings, and the fitting of ropes at Type III and Type IV exits to facilitate emergency egress from landplanes.

As part of the Agency recodification program, the relevant portions of Part 4b have been incorporated into Part 25 [New] of the Federal Aviation Regulations, and Parts 40 and 41, and Revised 42 of the Civil Air Regulations have been consolidated into Part 121 [New] of the Federal Aviation Regulations. Therefore, the amendments proposed for § 4b.362 now are made to §§ 25.809, 25.811, and 25.813, respectively covering emergency exit arrangement, marking, and access. Likewise, the amendments proposed for §§ 40.40, 40.173, 40.178, 40.265, 40.267, and 40.370 of Part 40, and the similar amendments proposed for Parts 41 and Revised 42, now are made by adding a new § 121.291 and Appendix D covering demonstration of and criteria for emergency evacuation procedures; by amending paragraphs (f), (g), and (h) of § 121.309 to make them effective only until July 1, 1966, and adding a new § 121.310 covering the emergency equipment items from that date; and by striking out §§ 121.393 and 121.396, and amending §§ 121.391, 121.397, 121.571, and 121.573, covering flight attendants, emergency and emergency evacuation duties, and briefing of passengers before takeoff. In addition, the term "certificate holder" will be applied to operators under Part 121 [New], in conformity with the recodification style.

In general, the comments received, both before and at the Public Hearing, indicated agreement with the intent of the Agency to improve safety in case of emergency evacuation. A number of comments were directed at individual, others at many, items covered by these amendments. These are discussed in the order of the categories listed above.

(1) Comments were made that the proposed rule for demonstration of emergency evacuation was unnecessary and would not materially assist in crewmember training and proficiency, or that if required at all it should be conducted by manufacturers. The Agency does not agree with these comments. It believes that demonstration for passenger-carrying airplanes, conducted by the operator, is in keeping with the public interest and will result in the saving of lives that otherwise might be lost in the absence of showing of ability to evacuate airplanes and the correction of faults in designs and procedures revealed by the tests.

Review of CAB accident report data showed that a large number of passengers involved in survivable accidents survived the crash impact but died as a result of asphyxiation because they were unable to evacuate the airplane.

During the period 1960–1963 there were four survivable air carrier accidents with 106 fatalities and 137 survivors. The record indicates that additional people could have survived if the passengers had been properly briefed or directed in the emergency evacuation of the airplane.

Evacuation tests conducted before the Public Hearing disclosed deficiencies in equipment, procedures, and training. The Agency believes that the tests required by these amendments will continue to contribute improvements in these areas.

As proposed in the Notice of Public Hearing, in order to make the tests as realistic as possible but without endangering the participants, these amendments require demonstration in both simulated aborted takeoff and gear-up crash landing. In addition, a separate demonstration for ditching is required for certificate holders conducting or proposing to conduct extended overwater operations, but without a maximum time period. Alternate methods are provided for the ditching demonstration, as requested by one air carrier, namely use of mockups or simulated floating devices.

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Hearing proposed that a new demonstration be required upon any increase in passenger seating capacity. This has been changed to require the new demonstration only when the increase in capacity is five percent or greater, thus allowing some latitude.

Also, the Notices would require demonstrations for airplanes of all sizes. These amendments require demonstrations only for airplanes with seating capacity of more than 44 passengers. After consideration of the relatively small size of the passenger cabin, close proximity of crewmembers, and past experience showing comparatively little difficulty in emergency evacuation, the Agency believes demonstrations need not be conducted for these smaller airplanes.

In line with one air carrier's comment, the criteria for conducting the demonstrations are spelled out in detail and set forth in Appendix D to Part 121 [New]. Several minor changes suggested by comments have been made, such as designating the certificate holder as the one to clutter aisles with blankets and other articles that normally would be in the passenger compartments; requiring a more representative passenger load; requiring either the blacking out of windows or the outside placing of mats, ramps or stands; forbidding rehearsals of demonstrations; and making clear that one demonstration must be conducted with outside darkness. Some suggestions were not adopted. For instance, it was suggested that smoke should be used during a demonstration. However, the Agency feels that this would tend to excite the passengers used, and create a hazardous condition. Similarly, a suggestion that "trained passengers" should be used, was not adopted.

One air carrier proposed a 90-second maximum time period for the demonstration of emergency evacuation of passengers in a survivable accident. The Agency has considered the relative speed in which fires have developed in accidents, and the practical limitations imposed by existing aircraft configurations, and has concluded that the two-minute maximum time period is reasonable for the aborted takeoff and gear-up crash landing evacuation demonstration. No maximum time period has been provided for the ditching demonstration, since experience shows that passengers generally are alerted prior to, and fire rarely occurs in, actual ditching.

These amendments provide that emergency evacuation demonstration must be conducted within 30 days after their effective date (120 days after issuance). This time period has been fixed after consideration of all relevant factors including the fact that in many cases satisfactory demonstrations for aborted takeoff already have been shown. Since these were conducted and approved under the criteria of the Agency's Order FS-8400.4 issued September 16, 1963, that are now placed in Appendix D with minor changes, a certificate holder who has conducted this particular demonstration need not again show it.

(2) Some comment urged that battery-powered megaphones would be of no assistance in evacuation and would create a hazard by the user's getting in the way of evacuees; that interior acoustical material would absorb a large proportion of megaphone output, and the high energy level required to overcome this absorption would result in "feed-back" on the megaphone; that a megaphone would require two hands for use by most persons to hold it steady and guard against feed-back; that the use of two megaphones would result in conflicting instructions; and that megaphones would not be advantageous in emergencies because of their location. The Agency believes megaphones will be of assistance in communications, as stated in Notice 63-42. As to the claim that megaphone users would impede evacuees, the Agency believes that such a person would not have received proper training with the equipment. As to absorption of megaphone output by interior acoustical material, the Agency believes this would not exceed the absorption of verbal instructions, and that there would not be inordinate feed-back from the output needed to overcome absorption. Also, it appears that one manufacturer has solved the absorption problem satisfactorily with its design of megaphone. As to the claimed need to use both hands to handle a megaphone, this is not necessarily so, since the design of the megaphone would be a controlling factor. The Agency does not believe that the requirement of two megaphones,

where there is a seating capacity of more than 99, will result in conflicting instructions if proper training is given to their users. Finally, the Agency believes the location of a megaphone in the rearward end of the passenger cabin, plus a second one in the forward end in a larger airplane, each in a place readily accessible to crewmembers assigned to emergency evacuation, will provide advantageous opportunity for the use of this equipment.

(3) The items are discussed separately below.

(4) Some comments objected to oral briefing of passengers on the location of emergency exits, urging that it would be sufficient to call their attention to safety cards. The Agency considers oral briefing prior to each takeoff necessary in the interest of safety. It believes that passengers so alerted are better prepared to cope with evacuation of the airplane under emergency conditions. Passengers do not always familiarize themselves with briefing cards after boarding the airplane and before takeoff, since they may be primarily concerned with securing desirable seats, making themselves comfortable, and observing fellow passengers. The Agency has concurred with the recommendation that oral briefing should be supplemented by printed cards. Accordingly, these amendments require the carrying, aboard passenger-carrying airplanes, of cards with diagrams of the emergency exits and details of the oral emergency instructions. The Notice proposed that for extended overwater operations passengers should be briefed as to both location and operation of liferafts. Briefing or operation of liferafts literally would require their removal from storage receptacles and physical demonstration of their activation. This is impractical, and has been omitted in these amendments.

One comment recommended that the passengers be required to keep their seat belts fastened during flight. This was not within the scope of the published Notices. However, the Agency has directed letters to all airlines suggesting that in the preflight briefing the passengers, for their comfort and convenience, should be advised to keep their seat belts loosely fastened in flight except when leaving their seats.

(5) With respect to flight attendants on passenger-carrying airplanes, Notice 63-42 proposed that one flight attendant be required on each airplane with a capacity of more than nine passengers, as in Part 40, plus additional flight attendants as determined necessary to comply with the provisions for assignment of emergency evacuation functions for crewmembers. The Notice of Public Hearing, however, applied the type of rule used in Parts 41 and Revised 42, with an additional fourth flight attendant on airplanes with a passenger seating capacity of more than 149, and with provision for approval of fewer flight attendants in certain circumstances.

Comments were made both for and against each approach. In the light of these comments and further study, the Agency has decided to adopt the latter approach. When the rule for three flight attendants was first instituted for airplanes with a seating capacity of more than 99, some airplanes had a seating capacity up to 135 passengers. Now some airplanes are equipped to carry up to 189 passengers. This highlights the need for expeditious performance of emergency functions by crewmembers, and the handling of passengers in survivable accidents. The successful emergency evacuation of these passengers will depend to a large extent upon the number of attendants, their training, and the evacuation procedures used by the operator. Some comments urged that in determining the number of flight attendants, consideration should be given to what services are rendered, such as food, or to what may be indicated by a demonstration. However, after consideration of all relevant factors, the Agency believes that the number of passenger seats on the particular airplane should be the basic minimum standard upon which to determine the number of flight attendants, as has previously been done in Parts 41 and 42 of the Civil Air Regulations. One comment suggested the use of one flight attendant for each Type I emergency exit. However, the Agency, after study, has concluded that this is not essential, since in survivable accidents one or more flight crewmembers likely would be available to assist in the emergency evacuation of occupants.

(6) A comment has been adopted that

assignment of emergency evacuation functions should be made to categories of crewmembers rather than to individual crewmembers. However, the Agency has not considered necessary the certification of flight attendants, as recommended by several comments. The Agency believes that the conduct of emergency procedures primarily is a problem of adequate crew training, currently provided for and proposed in the regulations, and that this training can be accomplished without certification.

(7) As to emergency exit arrangement, it was urged that the use of ropes to assist passengers to the ground from over-the-wing emergency exits would be of little value, obstruct exits, slow down descent, or create opportunities for injuries from flap edges or from the crossing of ropes at leading and trailing edges of wings. It also was urged that tapes should be permitted as an alternate means, and by one comment that details of design of the assist should be omitted. One comment suggested that rope strength should be for at least 1000 pounds. Upon re-examination, the Agency has decided to retain the proposal, changed (as proposed in the Notice of Public Hearing, pursuant to comment and study) to require ropes with a minimum diameter of ⅝ inch, or approved equivalent devices, in order to provide the handling characteristics necessary for passenger evacuation. The Agency's investigation of ordinary tapes showed that in general they do not provide sufficient diameter or area for a person to grasp in order to regulate his descent without burning the hands or incurring other injury. However, some types impregnated with latex appear to be satisfactory and in fact have been approved. Comment also was made that, in the case of crew exits, visibility in flight might be seriously reduced by the presence of the assist device stowed at or above the exit. Responsive to this comment, the amendments permit attachment to the fuselage structure at another approved location, in such a case.

In new § 121.310 of Part 121 [New], DC-3 airplanes operated with no more than 35 occupants including crewmembers and no more than 4 exits authorized for passenger use, will be exempted from the over-the-wing and cabin window emergency exit requirements. Section 121.309(f) already does not require an assist device at rear window emergency exits on these airplanes. The Agency agrees with the comment that for all cabin window emergency exits and additionally for over-the-wing emergency exits, on these airplanes, which require no special means to assist descent, the installation of descent ropes is unnecessary.

As to emergency exit marking, it was urged that it would be too restrictive to require a locating sign on each bulkhead or divider preventing fore and aft vision, to indicate emergency exits beyond and obscured by it. This provision has been changed to allow location of such a sign elsewhere when it is impossible to place it on the bulkhead or divider. Similarly, under the amendments one locating sign now may serve two floor level emergency exits if they both can be seen readily from the sign. Also, some ceilings above the main aisle are too low to accommodate locating signs near over-the-wing emergency exits. These amendments therefore permit another location if it is more practical because of low headroom. Comments also suggested exterior lighting for evacuation, and emergency lights in cockpits, as part of the independent lighting system, and red lights between window panes in emergency exits. The Agency believes these suggestions may have merit, but further evaluation is needed before proceeding with rule making in this area. Similarly, recommendations were made that signs be luminous or have luminous paint, and that exits openable from the outside be identified by the single word "EXIT" in letters at least one inch high and visible from 50 feet. These are not within the scope of the Notices. Comment further was made that instead of two-inch bands around emergency exits openable from the outside, provision should be made, conforming with SAE ARP 577, that these exits should be identified by the single word "EXIT" colored to contrast with the background, or colored red. The Agency believes the two-inch color band is the superior method of marking these exits, and that any color contrast (not necessarily involving red bands, as suggested by one comment) will adequately serve to mark the exit location and operating instructions.

It was urged by one comment that exit identity and locating provisions should not apply to piston-powered airplanes certificated years ago and under rules different from those under which jet aircraft have been certificated. These provisions, it was claimed, would result in confusion because of the small size of the airplanes and large number of small exits. The Agency does not concur with this suggestion, since a number of these airplanes are currently in use in coach service, with increased passenger capacity that increases the need for emergency identity and location signs.

Comment was made that to require the illumination to be 0.05 foot-candles on the surface of each seat armrest along the main passenger aisle would be too restrictive. This provision has been changed to require the equivalent average illumination. Spelled out also is the provision on automatic functioning of lights, to make clear that this will apply to any interruption of normal electrical power, and that the independent lighting system must be armed, if necessary for operation, before each takeoff and landing and during taxiing. One comment urged that arming should continue from takeoff through landing. The Agency does not consider this essential.

As to emergency exit access, it was claimed that doors with positive holding devices between pasenger compartments are as safe as, or even safer than, curtains if they are properly latched during takeoffs and landings. It was further asserted that persons evacuating an airplane might easily become tangled up in curtains, particularly when unusual aircraft altitudes are involved. The Agency does not agree that doors should be used instead of curtains, especially since it is possible that doors may become jammed in crash landings.

Comment also was made that the provision on emergency exit access would be too restrictive for the Boeing 727 airplane, that is equipped with a ventral stairway as an exit requiring passage through a door in the pressurized bulkhead to reach it. In most 727 airplanes the ventral stairway is not a required exit, therefore the door in the pressure bulkhead need not be latched open for takeoff and landing. Furthermore, even where the stairway might be proposed as an emergency exit, the door would be a part of the exit and not a door leading to the exit, therefore these amendments are not too restrictive for these airplanes.

It was urged that since not all piston airplanes have crewmember standing room alongside each Type I and Type II exit and window exits not over-the-wing, the Administrator should permit exemptions (meaning deviations) where justified. The Agency concurs with this comment. Section 4b.362 of Part 4b of the Civil Air Regulations has had the requirement for crewmember standing room since December 20, 1951, but some airplanes certificated under the provisions of Part 4b in effect before that date were not required to have this space. However, in some cases this space can not be provided because of the location of primary aircraft structure in the area. Therefore, these amendments permit a deviation for an airplane certificated under those provisions of Part 4b if the Administrator finds that special circumstances exist that provide an equivalent level of safety.

Certain other comments recommended the withholding of action with respect to these amendments. However, effective dates have been fixed after consideration of any problems encountered in meeting those dates. The effective date for the amendments to Part 25 [New] and the related amendments to Part 121 [New] have been set 90 days after issuance. The equipment provisions of these Amendments to Part 121 [New] actually become requirements on July 1, 1966. Thus, ample time is allowed for whatever changes are needed for operating purposes.

It was urged that airplane operators that are not air carriers or commercial operators should not be required to comply with the proposed requirements for all Part 25 (4b) airplanes. With respect to these operators, the Agency has not considered retroactive requirements, and no proposal has been made to change Part 91 [New] of the Federal Aviation Regulations.

It was urged that there should be a clear understanding that work completed on a voluntary basis on turbo-jet airplanes, relative to emergency exit identity signs and interior cabin illumination, accomplished as recommended by the FAA-Industry Task Force, would meet the intent of the amendments on these items. These amendments incorporate changes in requirements on interior cabin illumination and locating signs for emergency exits that relax the proposals made in the Notice of Public Hearing. The Agency can not state categorically that work accomplished as recommended by the FAA-Industry Task Force will in every case comply with these rules. However, information available to the Agency indicates that the relevant modifications voluntarily made on turbojet airplanes, as indicated, will be in compliance.

It also was urged that air carriers be relieved from these amendments with respect to piston-powered airplanes. The Agency does not agree that retrofitting of piston-powered airplanes is unnecessary. The need for improvements in cabin interiors and emergency equipment is the same for piston-powered as for turbine-powered airplanes, high density seating is installed in the former as well as in the latter, and the emergency evacuation standards should be the same for all types of airplanes used by air carriers in their operations.

It was suggested that the emergency evacuation equipment and procedures should be made applicable to cargo airplanes. The Agency has this subject under consideration as a separate study.

Section 91.47 of Part 91 of the Federal Aviation Regulations, a recodification of Special Civil Air Regulations 389B, effective April 1, 1965 (29 F.R. 19096), prohibits, in certain cases, the operation of large airplanes in passenger-carrying operations for hire with more than the number of occupants allowed under § 4b.362 (a), (b), and (c) of Part 4b of the Civil Air Regulations. Certain listed types may be operated with up to designated numbers of occupants and corresponding numbers of approved passenger emergency exits. These rules are provided "notwithstanding any other provisions of this chapter." Paragraph (b) of § 91.47 provides that additional occupants may be carried if there are additional exits comparable to at least a Type II or Type IV exit, but not more than eight occupants may be carried for each additional exit. New § 121.291 will require new demonstrations of emergency evacuation procedures upon a five percent or greater increase in seating capacity over that previously approved for a certificate holder operating, under that Part, a type and model of airplane with a seating capacity of more than 44 passengers in its passenger-carrying operations. In order to make clear that a Part 121 operator may not increase occupancy under § 91.47 without complying with the redemonstration requirement of Part 121, these amendments add to § 91.47 a provision to this effect.

Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matter presented.

In consideration of the foregoing, Parts 25, 91, and 121 of the Federal Aviation Regulations are amended as follows, effective June 7, 1965.

(Secs. 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354, 1421, 1423, 1424))

Amendment 25–2

Cockpit Voice Recorders

Adopted: March 19, 1965 **Effective: March 26, 1965**

(Published in 30 F.R. 3931, March 26, 1965)

The purpose of this amendment is to revise the installation requirements for cockpit voice recorders. Under the present requirements of § 25.1457, each cockpit voice recorder is required to be installed so that it will record, among other things, the voice communications of flight crewmembers using the loudspeaker system. The communications received from the loudspeaker system together with communications received from several other sources are required to be recorded on the fourth channel of the voice recorder. At the time that these rules were adopted, it was thought that this could be accomplished through the use of a relatively simple switching arrangement. However, it has subsequently been found that the installation of the voice recorder so that it would record the required communications without a mixing of audio signals on the fourth channel, cannot be accomplished without complex switching, relay, and isolation amplifier arrangements. This would increase the complexity and the cost of the installation, with an attendant decrease in the operational reliability of the recorder. Further, such an installation could result in fragmentation of the recorded information due to switching between sources. For this reason, the Agency considers it necessary to amend the regulation to provide for the installation of the voice recorder so that it will record on the fourth channel, communications obtained from one source only. In this connection, the Agency has determined that the fourth channel should record communications from each microphone, headset, or speaker used at the stations for the third or fourth crewmembers and if the communications at such stations are picked up by another channel, then communications from any passenger cabin loudspeaker system should be recorded on that channel.

In addition to the foregoing, paragraph (b) of the regulation now requires one or more cockpit-mounted area microphones arranged to pick up continuously any voice communications by flight crewmembers when at their assigned stations on the flight deck. The purpose of this requirement is to record communications from the flight crewmembers that are directed to the first or second pilot stations. Furthermore, paragraph (c) requires that the voice recorder be installed so that the third channel records communications from the cockpit-mounted area microphone best located for recording voice communications originating at the first and second pilot stations. However, experience in the installation of voice recorders has shown that a cockpit-mounted area microphone installed so as to meet the requirements of paragraph (c) will also record the communications of the other flight crewmembers that are directed to such stations. Therefore the regulation is being amended to require the installation of only one cockpit-mounted area microphone and to require that it be located so as to best record the voice communications originating at the first and second pilot stations and the voice communications of other flight crewmembers directed to such stations.

The present regulations require that each voice recorder must be bright orange in color. However, it has been found that some of the most durable and heat-resistant finishes are yellow in color. Since yellow is also a conspicuous color, the regulation is amended to permit yellow as well as orange finish on the recorder container.

These amendments provide relief from certain voice recorder installation requirements which have subsequently been found unnecessary in the interest of safety. Therefore, in view of the scheduling requirements and the time limits established under the operating rules for the installation of these recorders, any delay in issuing these amendments would impose an undue hardship on the operators.

For the foregoing reasons, I find that notice and public procedure hereon would be unnecessary and contrary to the public interest and good cause exists for making these amendments effective on less than 30 days' notice.

These amendments are issued under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423).

In consideration of the foregoing, § 25.1457 of Part 25 of the Federal Aviation Regulations (14 CFR Part 25) is amended, effective March 26, 1965, as follows:

Amendment 25-3

Minimum Flight Crewmember Requirements for Transport Category Airplanes

Adopted: April 21, 1965 **Effective: May 28, 1965**

(Published in 30 F.R. 6066, April 29, 1965)

The purpose of this amendment to Parts 25 (formerly CAR Part 4b) and 121 (formerly CAR Parts 40, 41, and 42) of the Federal Aviation Regulations is to establish criteria for determining, during the type certification process, the minimum required flight crew for each transport category airplane type certificated after January 1, 1964.

For airplanes type certificated after that date the requirement for a flight engineer, as well as other flight crewmembers, will be determined under the minimum flight crew criteria of § 25.1523. The minimum flight crew so determined will be the minimum flight crew for operation of the airplane under Part 121 or under other operating rules. The minimum flight crew established during type certification does not, however, include those additional flight crewmembers required under the operating rules for compliance with the flight time limitations or the performance of certain functions such as celestial or other specialized means of navigation.

This amendment is based on a notice of proposed rule making (Notice 64-21) issued on April 27, 1964, and published in the FEDERAL REGISTER on May 1, 1964 (29 F.R. 5805). As stated in the notice, the Agency believes that to continue to require a flight engineer solely on the basis of airplane weight is unrealistic for airplanes being designed today.

This amendment adds to Part 25 an Appendix D that contains the criteria that would hereafter be considered in determining the minimum flight crew under § 25.1523. Most of these criteria were listed in the notice of proposed rule making.

The Agency received several comments in response to the notice of proposed rule making. These comments, as well as those received at meetings with various groups representing air carriers, manufacturers, pilots, and flight engineers before issuing the notice, were all given careful consideration. A discussion of the major comments received and the Agency's position thereon follows:

Generally, the comments received from the aviation industry and from the airlines supported the Agency's proposal.

The International Brotherhood of Teamsters (representing the flight engineers from certain airlines) generally opposed any immediate change in the present rule and specifically stated that the proposal should be held in abeyance until the Civil Aeronautics Board issued its findings in a cockpit safety analysis that was underway when the notice was issued. The CAB study has now been completed and the Agency has carefully considered the conclusions reached therein as more fully discussed hereafter in this preamble.

The Flight Engineers International Association agreed that operation of an airplane that weighed in excess of 80,000 pounds without a flight engineer would not necessarily be unsafe solely because of weight. The FEIA, however, did not feel that the Agency's proposal justified elimination of the 80,000 pound rule at this time. FEIA felt that the methods used in the present type certification determination under § 25.1523 (former CAR § 4b.720) are not adequate for determining the minimum flight crew that safety would require, when factors are considered such as weather, icing communications, navigation, terrain, airline operational requirements, degree of crewmember fatigue, emergencies in the passenger cabin, passenger problems or reaction to existing conditions, and incapacitation of a crewmember. The Agency believes that the appendix being added to Part 25 by this amendment includes all of the factors that the FEIA feels must be considered in the type certification process. The FEIA also felt that the Agency's issue of the notice might prejudice the CAB study previously mentioned.

The Civil Aeronautics Board, upon completion of its study, submitted a comment generally concurring with the changes proposed in Notice 64–21. In this comment, the Board stated that the minimum flight crew determined during type certification "should be compatible with safe continued operation for at least one-half of the airplane endurance in the event of incapacitation of one of the pilots". In addition to the CAB and the FEIA comment, the Agency also received several other comments that mentioned "incapacitation" as a specific item that should be considered during the type certification process. "Incapacitation" is to a limited extent considered in the emergency considerations described in items (6) and (9) of the workload factors discussed in the notice and that are being set forth in Appendix D. However, the Agency agrees that it is desirable to make it clear that the possible incapacitation of one of the minimum required flight crewmembers is given particular attention during the type certification of an airplane to be used in operations under Part 121 or under any other operating rule that requires a minimum flight crew of two pilots. Accordingly, a separate item on incapacitation has been included as item (10) of the workload factors in the appendix to make it clear that the minimum required flight crew established for such operations provides for the continued operation of the airplane to a safe landing in the event that a flight crewmember is incapacitated during flight.

The Air Transport Association stated that the determination as to the required number of crewmembers for a given airplane should be made at the design stage and that this determination should not be changed during later stages of the type certification process. While it is true that many decisions will be made at the drawing board and design stage, the Agency believes that the final determination of the required minimum flight crew can not, in all cases, be made based on a cockpit mockup. The Agency believes that the final determination of the minimum flight crew should remain open until all of the type certification flight tests are completed. Thus, for example, if preliminary design data and mockups indicate that a two-man crew is adequate and if later findings indicate that such a crew would be unsafe, the Agency would not hesitate to require a larger minimum crew. In this regard, the Agency does not agree with the Air Transport Association that an unchangeable decision as to the minimum flight crew should be made at the design stage.

While the Agency agrees that a decision to increase the minimum flight crew for a new airplane would cause numerous problems (both economic and other) if made at the flight test stage, nevertheless, for the reasons previously stated the Agency believes that a binding decision cannot, as a matter of safety, be made until the final stages of type certification are reached. Undoubtedly, in a vast majority of cases, the decision made at the design stage will prove to be correct but the opportunity to change an incorrect decision made at this stage must be retained by the Agency if it is to fulfill its duties under the Federal Aviation Act.

Furthermore, the Agency believes that it would not be justified in retaining the present arbitrary cutoff based on weight that almost all of the commentators admit is really irrelevant merely because the decisions that must be made in determining the minimum required flight crew under the type certification process will not always be easy.

FEIA also stated that, if the minimum crew is to be based solely on the type certification determination, the Agency should give all interested parties a formal opportunity to comment whenever during the type certification procedure the Agency formed the opinion that a flight engineer would not be required for an airplane having a maximum certificated takeoff weight of more than 80,000 pounds. The Agency does not agree that any formal procedure for receiving comments on any individual decision during the type certification procedure should be established. The Agency, as a matter of course, obtains the views of many interested parties during type certification. In the absence of an arbitrary cutoff, such as the 80,000 pound rule, we believe that if anything, much more specific attention will be given to the minimum required crew in all future type certification processes.

The Air Line Pilots Association also stated that determinations now being made during type certification in establishing the minimum required flight crew are only a few of the determinations required to be made. This Association stated numerous items such as "weather", "runway conditions", "ATC and Traffic Conditions" that it felt could not be simulated. It further contended that the flights conducted during the certification process could not adequately determine such factors since such flying is "totally different from actual air line operating requirements."

The Agency does not agree that the flight tests conducted during type certification are totally different from actual air line operations. The Agency believes that a sufficient number of the 200 to 300 hours in type certification flight tests are operations representative of the kind in which the airplane will actually be used when type certificated. In view of the criteria that will be used in determining the minimum required flight crew as set forth in Appendix D added to Part 25 by this amendment, the Agency intends that future type certification flight tests will even more closely approximate actual operating conditions that would be experienced in a typical operation using the airplane being tested.

Civil Aeronautics Board study.[1] As previously mentioned briefly, pursuant to a recommendation of the House of Representatives Committee on Government Operations the CAB undertook a "fundamental study and review of commercial airliner flight deck or cockpit design and operations, including cockpit configuration, the division of duties, and qualifications of crewmembers." In conducting its study, the CAB consulted virtually every segment of the aviation community involved in air transportation and received from many of the interested organizations comments comparable to those received by the Agency in response to Notice 64-21. The Board also had before it the Agency's proposal in Notice 64-21 and further obtained comments from Agency personnel. The Board's conclusions with respect to crew complement were:

"a. Maximum takeoff weight is not the best basis for the determination of minimum flight crew.

"b. The basis for minimum flight crew complement should be operational complexity and resulting workload.

"c. The current turbojet transport aircraft requires a minimum of three flight crewmembers to maintain a satisfactory level of safety."

The Agency's position on the first two conclusions quoted above has already been discussed. With respect to the third conclusion, it is clear from the CAB study that by "current turbojet transport aircraft" the Board meant the B-707, DC-8, and other airplanes in the same class, since the Board elsewhere in its evaluation stated that "Our present jet transports are all certificated for weights at least two or three times greater than 80,000 pounds." These airplanes were all type certificated with minimum required flight crews of at least three flight crewmembers using substantially the same criteria that this amendment adds as an appendix to Part 25. Compliance with these criteria will continue to justify a minimum of three flight crewmembers and therefore this amendment will not change the minimum flight crew that was required for these airplanes when type certificated.

Interested persons have been afforded an opportunity to participate in the making of this amendment (29 F.R. 5805, Notice 64-21), and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, Chapter I of Title 14 of the Code of Federal Regulations is amended as follows, effective May 28, 1965.

(Secs. 313(a), 601, 604, and 605, Federal Aviation Act of 1958; 49 U.S.C. 1354, 1421, 1424, 1425)

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[1] Jet Transport Cockpit Review, BOSP-8-5-1, Civil Aeronautics Board, Bureau of Safety, Oct. 1, 1964.

Amendment 25–4

Flight Crew Compartment Doors

Adopted: April 24, 1965 **Effective: April 30, 1965**

(Published in 30 F.R. 6112, April 30, 1965)

The purpose of this amendment is to delete from the provisions of Part 25 of the Federal Aviation Regulations, the requirement that a door, equipped with a locking means, be installed between the passenger and pilot compartments and to incorporate such a requirement in Part 121 of the Federal Aviation Regulations.

Paragraph (e) of § 25.771 requires that a door be provided between the passenger and pilot compartments and that this door be equipped with a locking means to prevent passengers from opening the door without the pilot's permission.

The purpose of a compartment door is to prevent the passengers of an airplane from interfering with the crew during flight operations. Such a requirement has been found necessary for large airplanes used by air carrier and commercial operators in passenger-carrying operations. Therefore, the requirements concerning the installation of a door between the pilot and passenger compartments have been appropriately set forth in the airworthiness requirements for transport category airplanes. Neither the airworthiness requirements for airplanes in the normal, utility, and acrobatic categories nor the operating rules applicable to such airplanes require the installation of a door between the pilot and passenger compartments.

However, there has recently been introduced into service small-size jet airplanes designed for executive use which have had to be certificated under the transport category requirements. Such airplanes, while having the same passenger capacity as piston engine airplanes certificated under the normal, utility, or acrobatic requirements, have exceeded the maximum weight limitation of 12,500 pounds because of the necessary increase in fuel load. In recognition of the fact that the compartment doors are not necessary on such airplanes, the Agency has granted several exemptions permitting them to be type certificated without having the doors installed.

In light of the foregoing, the Agency considers it appropriate to amend the regulations to permit transport category airplanes to be type certificated without the installation of a door between the pilot and passenger compartments rather than to continue issuing exemptions from the requirement. This amendment would have no adverse effect on the airworthiness of transport category airplanes since the door is not required as part of the airplane structure, nor is it necessary for the functioning of any required system or equipment in normal or emergency operation. At the same time, the operating rules set forth in Part 121 of the Federal Aviation Regulations applicable to air carrier and commercial operators are amended to incorporate the requirement for the installation of such a compartment door with a locking means.

Since this amendment merely transfers to the operating rules in Part 121, requirements which are currently applicable to airplanes used by air carriers and commercial operators and, in doing so, clarifies the requirements concerning the installation of compartment doors on transport category airplanes, the Agency finds that notice and public procedure thereon are unnecessary and it may be made effective on less than 30 days' notice.

In consideration of the foregoing, Chapter I of Title 14 of the Code of Federal Regulations is amended, effective April 30, 1965, as follows:

(Secs. 313(a), 601, 603, 604, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423, 1424)

Amendment 25-5

Altimeter System Requirements

Adopted: June 21, 1965 **Effective: July 29, 1965**

(Published in 30 F.R. 8259, June 29, 1965)

The purpose of this amendment to Parts 23, 25, 43, and 91 of the Federal Aviation Regulations is to increase safety and improve airspace utilization by revising design requirements dealing with airplane altimeter systems and by prescribing periodic inspections of systems installed in airplanes operating under IFR conditions. This action was published as a notice of proposed rule making (29 F.R. 3310) and circulated as notice 64-14 dated March 12, 1964.

The need for the amendment results from recognition that altimeter system accuracy depends on good system design and is adversely affected by operations at higher altitudes and at higher airspeeds. Further degradation of system accuracy occurs in service caused primarily by static pressure system leaks and by instruments that have deviated from their original calibrations.

Agency action to upgrade altimeter system accuracy began with notice of proposed rule making (27 F.R. 4340) circulated as Draft Release No. 62-22 dated April 27, 1962. Among other provisions, Draft Release 62-22 proposed that the accuracy of the altimeter system of each new type aircraft be determined by an in-flight calibration of a number of production aircraft, with further provisions for inservice checks of altimeter system performance. Because standard methods of calibration remained to be developed, and because the project scope indicated that the end result might best be achieved by increments in several separate rule making actions, Draft Release No. 62-22 was withdrawn as a notice of proposed rule making although it did state the Agency's long-range program to upgrade altimeter system performance. Notice No. 64-14, on which this amendment is predicated, accordingly was limited in scope to design and check of airplane static pressure systems and test of altimeters.

Subsequent to Notice No. 64-14, the Federal Aviation Agency recodification program was completed. As explained in the Notice, recodification has not altered the substance of the rules. CAR § 3.665 is now FAR § 23.1325; CAR § 4b.612(b) is now FAR § 25.1325; proposed CAR § 18.31 and a portion of proposed FAR § 91.170 have become FAR Part 43, Appendix E. The appropriate FAR identification will be used hereinafter.

In response to the notice of proposed rule making, the Agency received several comments objecting to the overall proposed changes. The main thrust of these unfavorable comments was that the new rules would impose costs disproportionate to resulting increases in reliability, utility, or safety and that the accident record of airplanes operated under the general operating rules did not justify the proposed changes.

The Agency must reject any contention that revised rules upgrading the accuracy of altimeter systems are unwarranted. Surveys have revealed that a high percentage of airplanes have leaky static pressure systems. Accident reports in certain instances have pointed to altimeter errors; in other unexplained accidents, errors in instruments dependent on static pressure source may not be ruled out as contributing causes. If increased safety and more effective airspace utilization are to be achieved, all airplanes operated in IFR conditions must meet the same altimeter system equipment installation standards to operate in controlled airspace.

The changes and comments relating to the various specific parts of the Federal Aviation Regulations are discussed in the following paragraphs.

FAR § 23.1325. The notice of proposed rule making provided that the influence of airplane characteristics not seriously affect the accuracy of instruments having static pressure connections, further specified certain static system design and installation details, required a system proof test, and made provision for countering icing conditions.

Section 23.1325(a) has been amended to specify that static pressure connections be vented so that external forces least affect instrument accuracy. This change relaxes the requirement of the notice and parallels the wording in the comparable section of Part 25.

One commentator would delete the system proof test on the grounds that it does not reveal errors caused by a poorly designed or located static source, and that, in any event, such small static leaks as it might divulge do not result in static system errors. The Agency, however, considers the proof test a necessary part of certification because, after the design is completed, system leakage becomes the major criterion which cannot be ignored until its effect is proven inconsequential.

Two commentators objected to proof testing the static pressure system in each production airplane. The rule, however, does not require test of each production airplane although that would be one way to demonstrate conformity to the approved type design. As suggested by another commentator, sample testing and production flight check could be another acceptable means of showing conformity if there were a showing of an adequate quality control system and compliance with the equipment function and installation requirements of § 23.1301.

The Agency does not concur with various comments recommending that it adopt the Air Force static system leakage rate at an arbitrary specified altitude with associated instruments disconnected. Since many static system leaks occur at instrument disconnect points, it is considered that a realistic test for Part 23 airplanes should be made with the instruments connected. Section 23.1325 (b)(2) has been amended, however, to allow a reasonable leakage loss tolerance with associated instruments connected at the airplane maximum operating altitude.

With regard to negating the effect of icing conditions, one commentator recommended deleting the requirement altogether in low-performance airplanes operating under VFR conditions. Two other commentators recommended that a protected alternate source of static pressure be allowed, while a fourth recommended use of an optional ice-free static pressure source of less accuracy where calibration is given the pilot.

Since static vent icing may occur during both VFR and IFR conditions with hazardous consequences, the Agency believes there is ample justification for anti-icing as a certification requirement on all airplanes employing a static pressure system for required instruments. In response to the comments, the proposed rule has been expanded to permit the use of an alternate static source having a prescribed accuracy tolerance, and, where needed, a correction card.

FAR § 25.1325. The notice of proposed rule making altered the existing rule in part by adding an anti-icing provision, by specifying certain installation and design details plus a system proof test, and by allowing an altimeter correction device bypass instead of an alternate altimeter system.

Several commentators contended that the proof test would be unrealistic because no tolerance was provided and it was unclear whether the specified test pressure referred to differential or absolute pressure. Further comments variously recommended adoption of military requirements for leakage rate with associated instruments disconnected, adoption of a 400-foot per minute rate at 40,000 feet, and adoption of different system tolerances for pressurized and unpressurized airplanes. The Agency agrees with the comments concerning tolerance and pressure ambiguity, and, accordingly, has amended the requirement for type certification to include proof test at a pressure differential corresponding to the certificated maximum operating altitude. The rule has been further amended to specify a reasonable maximum leak rate of 100 feet per minute with associated instruments connected. The Agency does not agree with the recommendation for different system tolerances for pressurized and unpressurized airplanes since an altimeter system must perform satisfactorily in the most critical range when the airplane pressurization system fails.

The Agency does not concur with the contention of one commentator that the notice is arbitrary in specifying that pressure remain unaltered when exposed to continuous and intermittent maximum icing conditions. An airplane is certificated for a certain severity of icing condition which applies to all required installations including the altimeter.

Further comments to the effect that automatic correction devices be required for high altitude—high speed airplanes and that correction cards be used where automatic correction devices are not available, were either beyond the scope of the notice or already covered by current functional and installational requirements.

It was suggested that the intent of the requirement for a correction device bypass or alternate systems be clarified. The Agency feels, however, that the objective of the requirement is adequately stated and that it would be impractical to be more specific in an attempt to cover all possible design features.

FAR Part 43, Appendix E. The notice of proposed rule making described new altimeter instrument tests for scale error, hysteresis, after effect, friction, case leak, position error, and barometric scale error.

In the interest of organizational unity, this appendix has been expanded to encompass the details of the static pressure system test and inspection as proposed in § 91.170 in addition to the altimeter instrument tests.

In response to several comments, the static pressure system leakage test has been amended to allow a leakage tolerance instead of the requirement that the system be leak free.

A number of commentators objected to the cost of upgrading altimeter standards and recommended that tests for scale error, hysteresis, and friction be limited to the maximum operating altitude of the airplane in which installed. The Agency concurs and the rule is amended accordingly.

One commentator suggested that all standard atmosphere data be taken from the same source. The Agency concurs and has used "U.S. Standard Atmosphere, 1962" as the sole source for altitude-pressure-tolerance values.

A comment contending that five test altitudes for low-performance airplanes is sufficient was not supported by any justification. Also a comment suggesting that test points be selected that fall precisely on the instrument 20-foot scale marks was considered unjustified since in normal test procedures, one quarter of a scale division is not difficult to estimate.

The Agency agrees that the 12-hour rest period at 29.92 inches Hg is an unnecessary hardship and has deleted it as a preliminary requirement in the scale error test.

One commentator recommended deletion of tests for hysteresis, after effect, friction, position error, and barometric scale error since scale error and case leak tests are sufficient to determine if the altimeter should be returned to service. Another comment stated that the barometric scale error test was too extensive. The Agency concurs that the position error test is unnecessary and it has been deleted. Other relief has been afforded by changing specified test points in the hysteresis test and reducing the barometric scale error test to only eight test pressures. The tests for hysteresis, after effect, friction, and barometric scale error are considered essential for checking the quality of the instrument and its indicating accuracy consistency and, therefore, have not been deleted.

The Agency did not adopt a recommendation that the 20,000 feet per minute rate of pressure change for the scale error test be reduced since no justification was presented.

Several commentators suggested creating new classes or categories of altimeters for different altitude ranges, with less stringent test criteria for those operating at the lower altitudes. The Agency does not concur in these recommendations since, for IFR operation, altimeter system test standards must be the same for all airplanes regardless of altitude of operation or whether the airplane is pressurized.

The Agency agrees with a recommendation that the altimeter be vibrated to remove friction effect before taking test readings and has amended the test procedure accordingly. However, a further recommendation that the vibration frequency be specified, if adopted, would impose an unnecessary burden since the purpose of vibration is to eliminate errors due to friction within the instrument.

In reply to a comment pointing to the impracticality of conducting each altimeter test at 29.92 inches Hg and 25 degrees C, the final rule has been changed so as to delete the 29.92 inches Hg pressure requirement and to prescribe appropriate allowances to be made when test temperatures are substantially different from an ambient of 25 degrees C.

FAR § 91.170. The notice of proposed rule making proposed this new requirement to provide for repetitive checks of the static pressure system in all general aviation airplanes and of altimeter instruments installed in airplanes operating under IFR conditions other than those coming under Part 121.

The amended § 91.170 properly charges the operator with responsibility for insuring that the airplane has been tested and inspected prior to flight in IFR conditions. The specific static pressure system test requirements have been removed from this section and incorporated into Part 43, Appendix E in order that the complete altimeter system test and inspection procedure be contained under one appropriate heading.

Three commentators indicated some confusion between the proposed 2-year inspection and the periodic airworthiness inspection of § 91.169 for aircraft having dual altimeters. New § 91.170 has been reworded to delete reference to periodic inspections and emphasize that the biennial special altimeter system inspection is a requirement independent of the annual or 100-hour inspection required by § 91.169. The final rule also emphasizes that each static system of a dual system, as well as each altimeter instrument, is to be inspected.

Two commentators pointed to hardships due to a shortage of Class I instrument repair stations. It is the Agency's position, however, that the new inspection requirements impose no undue hardship on operators since the inspection interval is long, and operations may be scheduled to place airplanes at repair stations. In any event, only IFR operations would be curtailed should the required inspection not take place. Some relief is afforded in the final rule by permitting the altimeter tests to be made by an appropriately rated repair facility rather than a certificated Class I instrument rated repair station.

Several commentators recommended in effect that the rule be extended to prescribe accuracy tolerances and periodic accuracy checks of instruments used in VFR conditions. While the recommendations have merit, they go beyond the scope of present rule making. Under the current regulations, when VFR flight conditions prevail, collision avoidance is primarily dependent on visual means rather than vertical separation by altimeter information.

The final rule has been changed to provide for a § 91.170 compliance date 1 year from the effective date of the amendment.

Interested persons have been afforded an opportunity to participate in the making of this amendment. All relevant matter submitted has been fully considered.

In consideration of the foregoing, Parts 23, 25, 43, and 91 of the Federal Aviation Regulations are amended effective July 29, 1965, as set forth below.

(Secs. 313(a), 601, and 603 of the Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1422)

Amendment 25–6

Limited Weight Credit for Airplanes Equipped With Standby Power

Adopted: June 24, 1965 **Effective: August 1, 1965**

The purpose of this amendment is to provide a limited increase in the maximum certificated takeoff and landing weights for airplanes equipped with rocket engines used to provide standby power. This action was published as a notice of proposed rule making and circulated as Federal Aviation Notice No. 63-41 (28 F.R. 11481), October 26, 1963.

Standby power is obtained from rocket engines and is separate from the power obtained from the airplanes' main engines. Standby power is available for a relatively short time for use in cases of emergency. Since this power is capable of producing a temporary increase in airplane climb performance, it can be useful in the takeoff and landing regimes of flight where its temporary nature is not a deterrent to its use.

Under currently effective regulations, there are instances when operators of transport category as well as nontransport category airplanes with a standby power rocket engine installed, must accept a decrease in the useful load of the airplane at least equal to the weight of the standby power installation. This regulation provides a means of restoring this loss in recognition of the potential increase in airplane climb performance afforded by standby power.

An applicant for an increase in the maximum weight in accordance with this regulation is required to present an approved standby power installation and to furnish certain limitations and information in the form of placards or Airplane Flight Manual amendments.

Interested persons have been given an opportunity to comment on this regulation and consideration has been given to all relevant matter presented. In this connection, the notice of proposed rule making would have required a placard containing a precaution concerning the potential fire hazard of the hot standby power rocket engine casing. However, based upon some of the comments, the Agency has now determined that the casings of the rocket engines used for standby power do not, immediately following the firing, attain temperatures as high as had been anticipated. Therefore, there does not appear to be a potential fire hazard with respect to such casings. For this reason, the proposed placard is not required in the final rule.

There were also comments objecting to the proposal insofar as it limited the increase in weight for multiengine airplanes to an amount which, together with the currently approved maximum weights, would equal the weight at which compliance is shown with the applicable one-engine-inoperative final takeoff or en route climb requirements with the standby power rocket engine inoperative. After further consideration of this provision, it now appears that there is a significant improvement in the one-engine-inoperative takeoff flight path due to thrust augmentation from the standby power, while at the same time there is only a small decrease in the subsequent one-engine-inoperative climb performance resulting from the weight and drag of the standby power rocket engine installation. Later stages of the en route operation are not considered critical since the progressive weight decrease of the airplane due to fuel burnoff compensates for the effects of drag created by the standby power rocket engine installation. Furthermore, service experience with airplanes which have been approved for an increased weight with a standby power installation does not indicate that the proposed limitation is necessary. For the foregoing reasons, the proposed limitation is not included in the final rule.

Another change being made concerns the weight which may be increased under this regulation. As proposed, there could have been an increase in the currently approved maximum takeoff and landing weights at which compliance with the applicable first minute and normal climb performance has been shown. However, the Agency now considers the requirement to be unnecessarily restrictive. For this reason, such a limitation is not contained in the final rule.

There was also a comment indicating that information should be made available to airport fire and rescue personnel concerning the precautions, if any, that should be taken with unused propellants in case of a fire. While this comment goes beyond the scope of this notice, it should be noted that on the basis of impact tests and fire tests with rocket engines, it does not appear that any special precautions would be necessary over and above those which would normally be exercised with respect to fires involving aircraft without standby power rocket engine installation. Tests in which rocket engines have been dropped from considerable heights above the ground have shown that the rocket engine propellant would neither explode nor ignite on impact. Other tests in which rocket engines have been placed in a bed of fire have shown that the propellant would ignite after the rocket engine was exposed to the flames for a relatively long period of time, but the severity of the burning propellant was considered to be no greater than that of a gasoline fire. In addition, the burning propellant did not cause the rocket engine to explode or to become a projectile.

Certain of the comments expressed the opinion that the regulation should require a flight demonstration of the performance capability and safety of operation of the airplane at the increased maximum weight with standby power inoperative rather than confining the flight demonstration to a showing that the rocket engines and their controls can be operated safely and reliably at the increase in maximum weight. The Agency recognizes that both the drag of the inoperative rocket engine and the increased weight for the standby power installation will, to some extent, reduce the performance of the airplane in all flight regimes. However, experience with airplanes which have been granted limited weight credit for rocket engine installation does not indicate a significant reduction in performance or that the limited weight increase adversely affects safety. Furthermore, when the rocket engines are operated, the climb performance is significantly improved over that of the same type airplanes wtihout rocket engines. This characteristic is ensured by the formula set forth in these amendments. Therefore, it is not considered that a flight demonstration is necessary. Should a unique installation be presented which has high drag and deleterious effects on performance, the required flight test of the rocket engine installation, which would involve a flight demonstration of the airplane, would give flight test personnel adequate opportunity to detect any unsafe condition.

A minimum "fail safe" requirement for all standby power installations in the form of dual rockets capable of being controlled and operated independently of each other was also suggested. While credit for the installation of more than one rocket engine would be permitted under this regulation, it is considered that such installation should be optional with the applicant. Adequate reliability will be assured for the rocket engine and its installation by the requirements that the rocket engine be type certificated, that the reliability of the installation be demonstrated, and that a safe-line limitation be observed for the rocket engine. The Agency does not believe that it is either appropriate or necessary in the interest of safety to require the installation of dual rockets.

A suggestion was made that the proposed regulation be changed to permit a weight increase of 2 percent above the maximum structural weight established for the airplane without standby power installed. In support of this suggestion, it was pointed out that fuel burnoff during taxiing, takeoff, and climb would compensate for a good part of the weight of the standby power installation before the airplane reaches its cruising speed. The Agency is aware that there may be airplanes which have a structural margin of at least 2 percent of their maximum structural weight. However, there may be others that were designed to the limits of the structural standards and the structural margin, if any, cannot be readily determined for each airplane. Furthermore, the temporary increase in climb performance which is available with standby power does not justify lowering the minimum structural standards.

Under Notice 63-41, the regulations concerning limited weight credit for airplanes equipped with standby power would have been set forth in a Special Civil Air Regulation. However, the regulations have subsequently been recodified and it has been determined that the provisions of Notice 63-41 should be incorporated into the airworthiness parts (Parts 23 and 25) of the Federal Aviation Regulations rather than in a special regulation. It is also considered appropriate to simultaneously incorporate the requirements of Special Federal Aviation Regulation SFAR-14 (formerly SR-426), "Performance Credit For Transport Category Airplanes Equipped With Standby Power", into Part 25 of the Federal Aviation Regulations. Since this action merely continues an existing regulation without substantive change and imposes no additional burden on any person, notice and public procedure thereon are unnecessary.

The result of incorporating the proposal into Part 23 of the FARs would be to exclude from its coverage those aircraft certificated under Part 4a of the Civil Air Regulations. However, the Agency has determined that there is a possibility that the operators of such aircraft may wish to take advantage of the increased weights authorized by this Amendment. Therefore a paragraph has been added to Appendix E of Part 23 to the effect that Part 4a aircraft may, for the purposes of increased weights due to standby power, be treated as if they had been certificated under Part 3 of the Civil Air Regulations or Part 23 of the Federal Aviation Regulations. This will permit operators of Part 4a aircraft to avail themselves of the privileges of this regulation to the same extent as operators of Part 3 (CAR) or Part 23 (FAR) aircraft.

The regulations covered by Notice 63-41 and the requirements of former SFAR-14 are both being set forth in new Appendixes to Parts 23 and 25. Appropriate references to these Appendixes have been made in the provisions of Parts 23 and 25 concerning the limitations on maximum weights in order to permit the continued use of the provisions of former SFAR-14 in determining maximum weights and to permit limited increases in such weights as proposed in Notice 63-41.

These amendments are made under the authority of sections 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, 1425).

In consideration of the foregoing, SFAR-14 is hereby rescinded and Parts 23 and 25 of the Federal Aviation Regulations (14 CFR 23 and 25), are amended as follows, effective August 1, 1965:

(Published in 30 F.R. 8467, July 2, 1965)

Amendment 25-7

Stability and Stalling Characteristics Requirements for Transport Category Airplanes

Adopted: October 8, 1965 **Effective: November 14, 1965**

(Published in 30 F.R. 13115, October 15. 1965)

The purpose of this amendment to Part 25 of the Federal Aviation Regulations is to modify certain stability and stalling characteristics requirements applicable to newly certificated transport category airplanes. It primarily deletes stick-fixed requirements and clarifies the stick force-speed relation for static longitudinal stability. For the cruise condition, the amendment reduces allowable control system friction and redefines the applicable speed range over which static stability must be demonstrated. The amendment further provides flight characteristics standards applicable in the event of failure or malfunction of automatic or power-operated flight control devices and, finally, states new lower limit criteria for discontinuing the stall demonstration in airplanes having inherent aerodynamic stall warning.

This action was published as a notice of proposed rule making (29 F.R. 1692) and circulated as Notice 64-6 dated February 4, 1964.

Currently effective Federal Aviation Regulations on this subject are a recodification of former Civil Air Regulations that included Amendment 4b-12 of CAR Part 4b (27 F.R. 2986, Mar. 30, 1962). Following adoption of Amendment 4b-12, the Aerospace Industries Association (AIA) requested reconsideration of the stability requirements there imposed on the grounds that the newly introduced stick-fixed stability requirements dictated design and were unnecessary for minimum safety. Based on these AIA comments and the experience gained subsequent to Amendment 4b-12 in the type certification of turbine-powered transport airplanes, the Agency published Notice 64-6, not only to delete the stick-fixed stability requirements, but also to provide for failure of stability augmentation devices and changes in the stability and stall demonstrations.

Notice 64-6 proposed to amend § 25.21 (formerly CAR § 4b.100) by adding a new paragraph to provide for continued safe flight and landing in the event of single failure in a stability augmentation or other automatic or power-operated device. A number of the comments received related to flight characteristics standards that should be made applicable in the event of such failure. One commentator, Service Technique Aeronautique Section "Etudes Generales" of Paris, France, suggested, with meritorious appeal, that an acceptable level of degraded flight characteristics could be related to the probability of an augmentation device failure. However, due to the lack of statistics on component failure and the resultant effect on flight characteristics, and because the recommendation is beyond the scope of the notice, it cannot be given favorable consideration at the present time.

Two sets of comments submitted in response to proposed § 25.21(e) represent divergent views on standards to be applied when augmentation devices fail. The Airline Pilots Association (ALPA), questioning the reliability and operational safety of stability augmentation devices in general would, in effect, require full compliance with flight characteristics requirements to be demonstrated with all artificial aids inoperative. The AIA would not require compliance with any specific flight characteristics as long as the pilot could continue satisfactory controlled flight and landing. When an augmentation device is built into an airplane in order to meet certain flight requirements, the Agency does not propose that the airplane comply with identical requirements in the event of device failure. At the same time, neither is it the intent to leave the regulation with no meaningful minimum standard to ensure that flight characteristics following failure are not degraded to an extent affecting safety of operations. The Agency must, therefore, reject that recommendation that would tend to subvert the purpose of the proposal by setting no compliance minimum. Insofar as the other comments were based upon unreliability of specific devices, the recommendations that followed are beyond the scope of the present rule-making action since unreliability affecting airworthiness would be dealt with by corrective action as prescribed under other regulations.

Reconsideration in the light of the various comments has clarified the importance of controllability characteristics notwithstanding the failure of stability augmentation or its secondary effect on other flight characteristics. Furthermore, because the word "satisfactory", as used in the notice, erroneously suggested continued compliance with all airworthiness requirements following single device failure, § 25.21(e) has been further amended to distinguish trim, stability, and stalling from controllability characteristics. In the event of single failure of an augmentation device, new separate subparagraphs now require safe controllability at the critical limits, full controllability and maneuverability compliance within a reduced, i.e., practical, operational flight envelope, and permit some degradation in the quality of the trim, stability, and stall flight characteristics.

Section 25.21(e) has been further amended by adding the word "malfunction" to make clear that it applies to the overly active (runaway) as well as to the inoperative devices.

The amendment to § 25.21 being made in this rule-making action concerns failures and malfunctions of stability and control devices. ALPA has submitted a petition dated April 16, 1965, that would, in effect, prohibit automatic devices that take over or directly act on the controls. While the new ALPA proposal relates to the present action, it was received after the closing date for comments on Notice 64-6 and goes beyond the scope of the notice and, therefore, will be given separate study to determine if further rule-making action is warranted.

In view of the purpose of the amendment to remove the requirement for stick-fixed stability from the regulations, the general stability section, § 25.171 (formerly CAR § 4b.150) is amended as proposed in the notice to include a provision for control feel (static stability).

Notice 64-6 proposed to amend the static longitudinal stability requirements of § 25.173 (formerly CAR § 4b.151) by deleting the elevator control surface displacement requirements from the introduction and paragraph (a), by reducing the cruising condition free return speed range contained in paragraph (b), by redefining the stick force gradient expressed in paragraph (c), and by adding a new paragraph (d) to clarify the intent of the regulations with respect to acceptable characteristics within the allowable free return airspeed range.

No comments were received on the proposed revision to § 25.173(a) and the paragraph is amended as proposed.

Because it is possible for control system friction effects to mask stability over much of the presently required speed range associated with cruise condition static longitudinal stability, Notice 64-6 proposed to amend § 25.173(b) by reducing the free return speed range from 10 percent to the lesser of 5 percent or 20 knots. With considerable justification, the AIA disagreed with this change on the grounds that there is no evidence to dictate a change and that no safety problem is involved. In support of its position, the commentator listed 8 transport category airplanes each having completely satisfactory flight characteristics, but 4 of which exceeded 5 percent. Seven of these airplanes, however, were below 6.7 percent, and the flight test data for the eighth airplane, which showed in excess of 8 percent on both push and pull sides, appears not applicable to the cruise configuration. Recognizing that the free return speed range covers various effects other than friction, and that the proposed lower numerical value may represent a too-strict limit, the Agency concurs that the 5 percent or 20-knot limit is unnecessarily severe. The Agency does not agree, however, that no change is warranted. Balancing the underlying intent behind the notice, i.e., to unmask stability by reducing friction, against the well-stated considerations advanced by the AIA, and pending further experience, § 25.173(b) is amended to specify a cruise condition free return speed range of 7.5 percent.

The present § 25.173(c) quantitatively defines stick force characteristic requirements that, prior to Amendment 4b-12, were stated only in qualitative terms. On the basis of experience indicating that a minimum gradient of 1 pound per 6 knots defines a satisfactory degree of static longitudinal stability, Notice 64-6 merely proposed to state this gradient as an average that would apply to the applicable speed ranges of the four flight situations of § 25.175.

The AIA submitted a comment in response to the notice, recommending that the average slope of the curve be stable without specifying a gradient. The AIA reasoning was that satisfactory and safe flight characteristics are not a function of the magnitude of the force gradient since force gradients are not the determining factor in speed changes, and it is sufficient merely to specify that no instability exists. However, the AIA recommendation cannot be accepted because it would allow low magnitude stick forces over a large speed range so that the pilot might not readily detect speed changes by "stick feel" even at speeds beyond the friction band range. The AIA recommendation would also permit an unstable slope of the stick force curve in the applicable speed range as more fully discussed later under § 25.175.

In view of the foregoing, § 25.173(c) is amended as proposed in the notice to provide that the average gradient of the stable slope on the stick force curve be not less than 1 pound per 6 knots.

Service Technique Aeronautique, while expressing agreement with the proposed § 25.173 (b) and (c), stated that additional requirements are needed to eliminate such control system abnormalities as friction, play, and elasticity, which are annoying to the pilot and make precise trimming of the airplane difficult. Such limitations have found favor in various U.S. and foreign military and civil air regulations. The commentator further recommended that the stick force gradient be correlated to the airplane's limiting load factor so that the latter would not be exceeded upon release of the control stick in an untrimmed condition. While both points appear valid and the recommendations have merit, the matters have not been a problem in the certification of transport category airplanes. Since the recommendations go beyond the scope of the notice, the Agency cannot consider them for inclusion in the present rule-making action.

Section 25.173 is further amended as substantively proposed by adding a new paragraph (d) that makes it acceptable for an airplane to settle on off-trim speeds within the friction range provided exceptional attention on the part of the pilot is not required to maintain desired trim speed and altitude.

Demonstration of static longitudinal stability requirements for the climb, cruise, approach, and landing conditions, as contained in § 25.175 (a) through (d) (formerly CAR §§ 4b.152-155), have been amended to delete reference to the elevator angle curve. This action meets the initial objection of the AIA that the present regulation dictates design and furthers the purpose of the amendment to delete requirements for stick-fixed stability.

Notice 64-6 proposed to amend § 25.175 (b) (formerly CAR § 4b.155) by redefining the cruising condition speed range within which the stick force curve must have a stable slope, and by further limiting the speed range to that attainable without exceeding a stick force of ±50 pounds. In response to the Notice, the AIA recommended that the regulation further specify an "average" stable slope for each of the three cruising conditions in order to be consistent with the wording of § 25.173(c). There is no inconsistency, however, between the provisions of § 25.173(c) and § 25.175(b). As stated before, the former section describes the average stick force gradient (or degree of stability) in numerical terms, that is necessary to be designed into an airplane over the applicable speed range. The latter section states the further requirement, unchanged from the current regulation, that the stick force speed curve have a stable slope at all points within the applicable speed range. The two sections state different requirements, each of which must be met. The commentator's suggestion would not insure compliance with the "local" stable slope requirement of § 25.175(b) and, therefore, cannot be accepted.

The AIA also recommended that the proposed speed range over which § 25.175 (b) is applicable, be the lesser rather than the greater of the two listed alternatives. It was the commentator's reasoning that since the free return range had been added to the speed range, it would be reasonable to use the smaller value. However, since the intent was to insure stability demonstrations over a reasonably adequate speed range beyond the friction band, the Agency believes it necessary to specify the greater of the values, and therefore must reject the recommendation.

In response to the original AIA petition, Notice 64–6 proposed to limit the static longitudinal stability demonstration of § 25.175(b) to a speed range in which the control force does not exceed 50 pounds in place of the present regulation that limits the stick force to 50 pounds over a prescribed speed range. No comments were addressed to this proposal and the section is amended accordingly.

Agency reconsideration of the proposed § 25.175(b)(3) (formerly CAR § 4b.155(c)) has indicated a void in the requirement for demonstrating stability in the speed range between trim speed and the landing gear extended speed (V_{LE}) when the airplane is trimmed below the V_{LE} speed. There was no intent in the proposal to change the currently effective requirement for demonstrating stability up to the V_{LE} speed. In addition, the subparagraph was inconsistent with § 25.175(b) (1) and (2) prescribing speed ranges that take into account the friction band. The reasons for demonstrating stability over a reasonable speed range beyond the friction band, and for adding free return speed range to the numerically-specified speed range, are as equally applicable to the landing gear extended as to the landing gear retracted conditions. Accordingly, § 25.175(b)(3) is further amended to eliminate the deficiencies noted and to make it consistent with the other portions of the section.

The proposed change to § 25.201(c)(2) (formerly CAR § 4b.160(c)(2)) would amend the exception clause to allow discontinuance of the stall demonstration when the magnitude and severity of an unmistakable inherent aerodynamic warning becomes a strong and effective deterrent to further speed reduction. The AIA submitted comments in opposition to this change, contending that it would reduce the level of safety provided by the present regulation. It was the AIA position that deletion of cross reference to § 25.207, which precludes unsatisfactory characteristics between stall warning and full stall, would allow declaration of the stall in or on the edge of pitchup, wing drop, etc., so that margins would not be defined between speeds to which an airplane is exposed in training and possible uncontrollability. The Agency, however, is unable to agree with the reasoning of the commentator since the criteria for determination of an acceptable unmistakable inherent aerodynamic warning have clearly been strengthened in the proposal to require a deliberate and extensive pilot effort to reduce the speed below that at which the limiting warning occurs. Furthermore, the § 25.201 proposal does not relieve compliance with § 25.207 in regard to the stall warning margin as the AIA comments seemingly imply. The Agency believes the proposed changes to § 25.201 will increase safety, and the section is amended accordingly.

In this connection, § 25.207(c) requires the stall warning to begin at a speed exceeding the stalling speed by 7 percent or some lesser margin under stated conditions. A question arises as to whether, under the amended exception clause of § 25.201(c)(2), § 25.207(c) requires the stall warning to begin at a speed exceeding the speed at which the warning becomes a strong and effective deterrent to further speed reduction. To indicate that the stall warning margin must exist above the speed demonstrated under the exception clause of § 25.201(c)(2), § 25.207(c) has been amended to clarify the stalling speed on which the margin is to be based.

Safe Flight Instrument Corporation, referencing an apparent inconsistency between § 25.201(c)(2) and § 25.207, recommended that the exception clause of the former be further amended to allow artificial stall warning as an alternative to inherent aerodynamic warning to deter further speed reduction during an approach to the stall. It is assumed the "inconsistency" cited refers to the wording of § 25.207(b) that allows use of a device giving clearly distinguishable indications, whereas § 25.201(c)(2) makes no provision for artificial warning to terminate the stall demonstration. The commentator's allegation of inconsistency, however, fails to distinguish the two sections and is not well taken. Section 25.207 requires a stall warning at a margin above stall speed but optionally allows use of a device for this purpose because inherent warning may not occur at the higher speed. Section 25.201, on the other hand, requires demonstration of "inherent" airplane characteristics at the lowest speeds possible in operations. To limit the scope of the demonstration by use of artificial warning devices would be clearly incompatible with the purpose of the section. The Agency finds no inconsistencies in the two sections and therefore cannot accept the recommendation of this commentator.

A number of nonsubstantive changes have been made to clarify wording and correct inadvertent editorial omissions occurring in the notice.

Interested persons have been afforded an opportunity to participate in the making of this amendment. All relevant matter submitted has been fully considered.

(Secs. 313(a), 601, and 603 of the Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1422)

In consideration of the foregoing, Part 25 of the Federal Aviation Regulations is amended, effective November 14, 1965, as follows:

Amendment 25–8

Installation Requirements and Revised Minimum Performance Standards for Flight Recorders

Adopted: December 29, 1965 Effective: February 5, 1966

(Published in 31 F.R. 125, January 6, 1966)

The purpose of these amendments is to establish installation requirements for flight records on transport category airplanes and to revise the minimum performance standards for the manufacture of flight recorders. These amendments are designed to increase the accuracy of recorded information and to improve the "crash survivability" of this information.

There are presently no Federal Aviation Regulations governing the installation of flight recorders in airplanes. In the past, flight recorders were installed in accordance with policy guidelines set forth in CAM 4b.606–2. In Notice 65–4, published in 30 F.R. 2468 on February 25, 1965, the Agency proposed to update the policy material and to incorporate it into Part 25. The proposed requirements generally followed the installation requirements for cockpit voice recorders.

The amendments set forth hereinafter are based on, and reflect the pertinent comments concerning, Notice 65–4. Except as modified by the following discussion, the reasons for these amendments are those contained in the notice.

1. Amendments to Part 25: In connection with the foregoing, the proposed rule has been changed in response to comments received, to permit the first pilot's compass system to be used as a recorder data source. Moreover, the proposal has been revised to make it clear that it is the data obtained from "sources other than the first pilot's instrument system" that must meet the specified accuracy requirements rather than the recorded data. In addition, the regulation has been changed to permit the flight recorder to be connected to the same central air data systems (CADS) as the first pilot's instrument system, notwithstanding the provisions of § 25.1333. The Agency is aware that the accuracy of recorder information would be improved

if the recorder used the CADS for data input.

Certain of the comments received regarding the vertical acceleration sensor requirement were concerned with the necessity of making the required relocation on existing installations within the compliance time specified in the proposed amendment to § 121.343. However, as discussed in more detail hereinafter, the June 1, 1966, compliance date has been substantially extended, therefore the affected operators should have sufficient time to make the necessary change. Moreover, the Agency is aware that with respect to at least one flight recorder, the manufacturer has issued a service bulletin containing the necessary design data for a remote "g" sensor modification. The Agency is aware of the expense involved in the relocation of a "g" sensor. However, the Agency is also aware that the true vertical acceleration of the airplane can only be measured directly when the sensor for the acceleration is located within the center of gravity (c.g.) range of the airplane. The extent of the "g" error for other sensor locations is great enough to warrant a direct measurement requirement, notwithstanding the expense involved.

In response to comments concerning the scope of the preflight recorder check required in this amendment, the Agency has revised the proposal to make it clear that a means for a preflight check of the recorder for proper tape movement is all that is required.

Numerous comments were received concerning the proposed requirement for recorder location. In this connection, the comments pointed out that locating the recorder aft of the fuselage pressure bulkhead would adversely affect the recorder system accuracy and would be an undue burden because of the expense involved. Other comments were concerned with the fact that not enough space would be provided for a practical recorder installation beyond the pressure envelope, that such a location would be difficult with respect to "swing tail" airplanes, and that hydraulic fluid vapors which are sometimes present in the unpressurized areas, may seriously affect recorder operation. Finally, it was pointed out that the proposed location for flight recorders was inconsistent with the voice recorder location requirements.

While the Agency generally agrees with the comments concerning the requirement to locate the flight recorder aft of the pressurized compartment, it does not believe that recorder accuracy would suffer from such a location. However, the additional expense in locating the recorder within the unpressurized area together with the problem of limited space, the problem associated with "swing tail" airplanes, and the possible adverse effects of hydraulic fluid vapors on the recorder, provide a valid argument against such a location. Therefore, the Agency considers it appropriate to relax the proposed requirement and apply standards consistent with the location requirements applicable to cockpit voice recorders.

In addition to the foregoing, comments were received which stated that recorder survivability may worsen if recorders are located in the aft fuselage and suggesting that the rule permit the installation in radio racks of flight recorders designed for installation in such racks. The Agency is aware, however, of the severe damage incurred by recorders located in the fuselage center section, and forward, of airplanes involved in accidents, while on the other hand, accidents have occurred in which only the aft fuselage and tail section escaped substantial damage. As indicated in Notice 65-4, experience has shown that a nonejectable record container stands the best chance of surviving crash impact forces if it is installed in the aft fuselage area.

In response to the comments from various operators objecting to the correlation test requirement as proposed, the final rule has been expanded in an effort to more clearly state the scope of the tests required. Moreover, based on correlation tests conducted by the Agency in flight and on the ground, the final rule expressly permits the correlation tests to be conducted on the ground. Some of the comments objected to the proposed correlation tests as being too expensive. However, it appears that these comments were made in the belief that the correlation tests had to be conducted in flight. Now, since the tests may be conducted on the ground, with effective programming they could be accomplished during the down-periods of the airplanes.

With respect to the proposed requirement that correlation data be included in the Airplane Flight Manual, the Agency now considers that in view of the nature of this data and since it is subject to change, it should not be incorporated in the Airplane Flight Manual. However, since this data is necessary for the proper interpretation of the flight-recorded information in the event of an airplane accident, it should be retained by the operators.

2. Amendments to Part 121: As previously referred to in the discussions concerning the amendments to Part 25, in the light of the numerous comments received concerning the proposed amendment to § 121.343, the Agency has determined that the proposed compliance date of June 1, 1966, is not realistic. However, the Agency does not agree with the opinion expressed by some of the commentators that 3 years should be allowed for compliance. After a thorough consideration of all the comments, views, and arguments presented concerning this matter, the Agency considers that a compliance date of December 15, 1967, allows the operators a reasonable period of time in which to make the required modifications.

In addition to the changes in the proposed amendment to § 121.343 previously discussed, the final rule requires the operators to retain the most recent flight recorder calibration, including the medium containing such calibration, and the recorder correlations. Consistent with Notice 65-4, under the amendments contained herein, the Part 121 operators as well as the airplane manufacturers would be required to correlate flight recorder readings of airspeed, altitude, and headings, with the corresponding readings (taking into account correction factors) of the first pilot's instruments. Such a correlation can only be accomplished after the flight recorder and the pilot's instruments have been calibrated. Thus, in order to conduct the correlations required in the amendments to Parts 25 and 121, both the manufacturers of new production airplanes and the operators must make the necessary calibrations. It was proposed that this information be incorporated in the Airplane Flight Manual. However, for the reasons set forth in the discussion concerning the amendments to Part 25, it has been determined that this information should be retained by the operators. This should impose no additional burden on any operator since it merely requires them to retain data that they must, in any event, prepare for their existing airplanes, and to retain data which has already been prepared by the airplane manufacturer on new production airplanes rather than incorporate such data in the Airplane Flight Manual. The Agency is aware that the air carriers currently retain their calibration data.

3. Amendments to Part 37: One of the comments received concerning the proposed change to the minimum performance standards for flight recorders under the Technical Standard Order system recommended that the impact tests for type III recorders include a height of drop or velocity of impact requirement. In this connection, it was recommended that type III recorders be subjected to a 50-foot drop. However, the recommended drop test has not been incorporated in the final amendment. In the first place, Notice 65-4 proposed only to amend the impact requirements for types I and II recorders. Moreover, the comment did not submit data to support the proposed arbitrary values and the present standard permits the applicant to perform rational tests taking into consideration the features of his device, including airplane attitude, which could result in impact velocities greatly different from a single arbitrary value.

There was also comment to the effect that the proposed impact shear force test requirements for flight recorders should provide more detail test procedures. The Agency considers that the proposal is adequate but that the test is really a test of penetration resistance rather than impact shear. The title to the proposed section 7.8.3 has been appropriately changed. Furthermore, in order to advise manufacturers of the purpose of the tests, the Agency has incorporated a clarifying Note in the final standard.

In response to comments received, the Agency has investigated the prospects of installing a gamma radiation source in, or on a flight recorder to assist in locating it after a crash. However, it appears that an impracticable and unsafe level of radioactivity would be required to overcome energy loss and permit detection through the amount of earth or water likely to surround the recorder.

There was also comment recommending that only ejectable and floatable recorders provided with a radio homing beacon be specified. This comment advocates the mandatory use of type III recorders only. However, there are no type III recorders fully developed and approved for use on air carrier aircraft as yet. Furthermore, the type I and type II recorders have provided useful information in a majority of accidents. With improved crash resistance, they should be even more successful. With respect to the inclusion of a radio beacon device, the Agency considers that such a beacon might be appropriate for type III recorders but not for the nonejectable types. However, the Agency considers that the intent of the proposal has merit and warrants further consideration.

A comment concerning the proposed performance standards suggested that the requirement for a breakaway mounting designed to yield or sever at applied loads be considered. It is assumed that this comment refers to the possible alleviating effect of a failure of the recorder mounting fixture allowing separation from the aircraft structure when the recorder case is subjected to a large external force or blow. This appears reasonable and the proposed test does not preclude testing the unit as installed in its external mountings.

It was also suggested that the proposed revisions to sections 7.8.3 and 7.8.4 should be changed to make it clear that the standards apply only to types I and II recorders. This is, of course, what the Agency intended and the sections have been clarified as suggested. Moreover, the provisions of section 7.8.3 have been clarified to specify the exact area of test bar contact. As now written, the standard would permit the use of other than a cylindrical bar.

Finally, the performance standards have been amended to require the manufacturer of the recorders to finish the exterior of the recorders in a bright orange or bright yellow color. While not covered in Notice 65–4, this should impose no additional burden on the recorder manufacturers since a bright yellow or orange color is already an installation requirement in Part 25.

The amendment to § 37.150 as contained herein sets forth the entire minimum performance standard for aircraft flight recorders revised as proposed in Notice 65–4 and as discussed in this preamble.

(Secs. 313(a), 601, 603, 604, 605, and 607, Federal Aviation Act of 1958; 49 U.S.C. 1354, 1421, 1423, 1424, 1425, and 1427)

In consideration of the foregoing, Chapter I of Title 14 of the Code of Federal Regulations is amended as hereinafter set forth effective February 5, 1966.

Amendment 25–9

Miscellaneous Amendments

Adopted: June 23, 1966 **Effective: June 30, 1966**

(Published in 31 F.R. 8911, June 28, 1966)

Requirements for emergency evacuation ropes at certain exists and for megaphones aboard aircraft; postponement of effective dates for cockpit voice recorders and certain emergency lighting requirements; and miscellaneous amendments affecting emergency evacuation requirements.

The purpose of this amendment is to make certain changes in the emergency evacuation equipment requirements of Parts 25 and 121 of the Federal Aviation Regulations, to postpone the effective date of some of these requirements, and to postpone the effective date of the requirement for cockpit voice recorders on large turbine engine powered airplanes.

The portions of this amendment relating to megaphones and emergency evacuation ropes are based on a notice of proposed rule making (Notice No. 66–13) issued on April 4, 1966, and published in the FEDERAL REGISTER on April 7, 1966 (31 F.R. 5495). The comments received in response to that notice generally concurred with the proposals contained therein. One comment, while agreeing that at times ropes from over wing exits can become entangled and impede evacuation, nevertheless felt that the Agency should require the use of ropes for all over wing exits for ditching purposes. The Agency believes that, pending completion of the current task force study discussed in Notice 66-13, both Parts 25 and 121 should be amended to restore the Part 25 requirement that existed before Amendment 25-1. Therefore, ropes or some other assisting means will be required at all exits more than 6 feet from the ground except over the wing exits. In addition, while the preamble to Notice 66-13 indicated that Part 25 would be amended to reinstate the requirement that existed before Amendment 25-1, the Agency believes that the 400-pound static load test and attachment requirements contained in that amendment should be retained. Therefore, for the reasons set forth in Notice 66-13, §§ 25.809(f) and 121.310(a) are amended to substantially reinstate the requirements for means to assist passengers in an emergency evacuation that existed before the adoption of Amendments 25-1 and 121-2, with the modifications mentioned above. In addition § 121.310(h) is amended to clarify the megaphone location requirement in Part 121.

Paragraph (b)(2) of § 121.310 requires that each passenger exit marking and locating sign required by paragraph (b)(1) "must have white letters 1 inch high on a red background 2 inches high, be self or electrically illuminated, and have a minimum luminescence (brightness) of at least 160 microlamberts." The Agency has discovered that in at least one airplane type the retrofitting necessary to comply with this requirement for over-the-wing exit signs would result in the placing of the sign at such an angle that part of the advantage gained by the larger sign is offset by decreased visibility. Accordingly, this section is amended to permit approval of a deviation from the 2 inch background requirement so that a slightly smaller but more effective sign could be approved where literal compliance would be impractical. Since the Agency still believes that the required exit marking signs are necessary it will approve deviations only where it can be shown that strict compliance with the requirement is impractical, and where the proposed configuration provides at least an equivalent level of safety.

A large number of Part 121 operators planned to comply with this exit marking and locating sign requirement by installing radioactive signs. The Agency has been informed by the airlines that because of the large number of orders placed with a few vendors, the vendors will be unable to deliver all the equipment in time to make installations before the July 1 compliance date. Therefore, since numerous airplanes will not be retrofitted by July 1 and would have to be grounded thereafter, the Agency believes that a postponement until September 15, 1966, is warranted. For the interim period the requirements of § 121.309(g) are being extended.

In establishing the original minimum brightness level for exit marking signs in §§ 25.811(d) and 121.310(b)(2) the Agency recognized that radioactive signs deteriorate. Therefore, while a minimum brightness level of 100 microlamberts was considered adequate for safe operations, the Agency established an installation minimum of 160 microlamberts. It was intended that this would be an adequate "manufacturing" minimum that would allow for a reasonable lifespan before a sign would deteriorate to a point where it would become inadequate and require replacement. However, since the 160 microlambert figure was specified in both Parts 25 and 121 without further qualification, this intent was not carried out. Therefore, § 121.310 (b)(2) is being amended to make it clear that all retrofit and replacement signs must be manufactured to the minimum specified in FAR Part 25. This figure (160 microlamberts) reflects present state of the art deterioration factors and insures that the signs installed in new aircraft and those purchased for retrofitting or replacement will have a reasonable lifespan. However, since the Agency considers a brightness level below 100 microlamberts inadequate for safety, Part 121 is being amended to require replacement of a sign that deteriorates below this level. Since the basic purpose of the 160 microlambert figure is to insure a reasonable useful life before deterioration to the 100 microlambert level, the Agency would also consider as meeting an equivalent level of safety under Part 25, a sign manufactured to an initial brightness level below 160 microlamberts but with a useful life (i.e., above the 100 microlambert level) at least equal to the useful life of signs presently being manufactured to or above the 160 microlambert level.

Section 121.310(c)(2) requires that after June 30, 1966, each passenger-carrying airplane must have a source of light, independent of the main lighting system, to provide enough general lighting in the passenger cabin so that the average illumination, when measured at 40 inch intervals at seat armrest height on the centerline of the main passenger aisle, is at least 0.05 foot-candles. Prior to the adoption of this requirement, the Agency-industry task force had found that the general emergency lighting in several of the then newer turbine engine powered airplanes was of a desirable minimum level and in fact met the 0.05 foot-candle requirement. Based on these findings the Part 121 operators owning these aircraft types did not arrange for any retrofitting to meet the general illumination requirements. Within the past several weeks it was discovered that due to a combination of lighting deterioration (aging), and the soiling of cabin interiors this requirement is no longer met by these airplanes. While the affected airplane manufacturers immediately started preparing the engineering data to accomplish the necessary changes, the required installations cannot be accomplished before July 1, 1966. For the foregoing reasons, the Agency is postponing the compliance date of § 121.310 (c) and (d) from July 1, 1966, to September 15, 1966. For the interim period the requirements of § 121.309(h) are being extended.

While these extensions should allow sufficient time for the necessary retrofitting, the Agency realizes that the changes required to bring all of the affected airplanes up to the general lighting minimum of § 121.310(c)(2) and to obtain the necessary signs to comply with paragraph (b) could cause a problem for some operators with large fleets. Therefore, a provision is included whereby such an operator can obtain a further extension, not beyond December 1, 1966, from the FAA Air Carrier District Office charged with the overall inspection of its operations.

On June 26, 1964, the Agency adopted amendments to former Civil Air Regulations Parts 40, 41, and 42 (29 F.R. 8401) requiring each air carrier and commercial operator to install a cockpit voice recorder on each large turbine engine powered airplane to be operated under those parts after July 1, 1966. This requirement was recodified as § 121.359 of the Federal Aviation Regulations. Until recently, it appeared that the airlines would meet the compliance date. However, several airlines found that their recorder installations had to be modified to fully meet the requirement of § 25.1457 (d)(2) that an automatic means be provided to stop each erasure feature from functioning at the instant of crash impact. The airlines affected petitioned the Agency for exemptions in order to avoid the grounding of airplanes after July 1, 1966, while the modifications were being made. In addition, recently several airlines discovered that one model voice recorder failed after from 30 to 70 hours of operation. The manufacturer of the affected recorder has corrected this problem. However, those voice recorders already delivered will have to be returned to the factory for repair and the manufacturer indicates that, despite its efforts to accomplish this work on an expedited basis, it will require at least 60 days after the July 1 compliance date to complete this work. Therefore, in order to provide the additional time necessary to accomplish the work required to correct these problems, the Agency is postponing the compliance date in § 121.359 for large turbine engine powered airplanes from July 1, 1966, to September 15, 1966. A provision similar to that discussed above is included to permit extensions beyond September 15, but not beyond December 1, 1966, where an operator is able to show that for reasons beyond its control it is unable to comply by the earlier date.

Interested persons have been afforded an opportunity to participate in that portion of this amendment relating to emergency evacuation ropes and megaphone requirements, and due consideration has been given to all relevant matter presented. The portion of this amendment not proposed in Notice 66-13 imposes no additional burden on any person and in view of the imminence of the effective date of the affected sections, I find that notice and public procedure thereon are impractical, and that good cause exists for making this amendment effective on less than 30 day's notice.

In consideration of the foregoing, Parts 25 and 121 of the Federal Aviation Regulations are amended as follows, effective June 30, 1966.

Amendment 25-10

Sonic Fatigue Evaluation

Adopted: September 6, 1966 **Effective: October 10, 1966**

(Published in 31 F.R. 11931, September 10, 1966)

This amendment requires turbojet powered transport category airplanes to be evaluated, during type certification, to show that either (1) sonic fatigue cracks are not probable in any part of the flight structure subject to sonic excitation, or (2) catastrophic failure caused by sonic fatigue cracks is not probable. This amendment is based on, and is issued for the reasons contained in, Notice 65-40, published in the FEDERAL REGISTER (30 F.R. 15670) on December 18, 1965.

One comment stated that present § 25.571 is already broad enough to cover sonic fatigue, that singling out sonic fatigue for detailed rule making confuses the present rule, that sonic fatigue effects are already adequately considered in type certification programs, and that this amendment is therefore unnecessary. As stated in the notice, present § 25.571 does not adequately cover sonic fatigue problems because (1) the present rule allows evaluation by analysis without tests, which is not the intent of this amendment, (2) the present rule allows substantiation of single principal structural elements, which is not the intent of this amendment, and (3) the present rule is adequate only for low frequency pressure loads, whereas sonic excitation involves high frequency loads. Since this amendment meets a specific fatigue evaluation problem specifically, and since the present general requirements are unchanged and continue to apply to all transport category airplanes, the comment that singling out sonic fatigue for separate regulation is confusing cannot be accepted. This commentator also stated that this amendment, if adopted, should specifically refer only to structure whose failure could result in catastrophic failure. This is the intent of the notice and is made clear in this amendment by the addition of a sentence to § 25.571(a) that refers to "those parts" now covered by that paragraph. The Agency also appreciates the fact that sonic excitation analyses have been included voluntarily in some type certification programs. However, since the purpose of this amendment is to provide a minimum design standard in an area involving possible catastrophic failure, such voluntary investigations, although appreciated, do not alleviate the need for regulation. This commentator further stated that the operation tests to which turbojet powered airplanes are already subjected during type certification are long enough, and severe enough, so that the service experience of sonically excitable parts is already sufficient, by the time that the type certificate is issued, to "substantiate an infinite life," and that this amendment is therefore not necessary. Where tests conducted during type certification in fact show that sonic fatigue cracks, or catastrophic failure caused by such cracks, are not probable, this amendment will of course add no further burden on the applicant. However, since a minimum standard of safety related to possible catastrophic failure is involved, it cannot be assumed that present testing will show improbability of failure in every case. Further, it is the intent of this amendment to allow compliance to be shown by analysis supported by tests (as well as by relevant service experience or by tests alone). This allowance should be specified in the rule. Therefore, this comment cannot be accepted. This commentator finally stated that, if this amendment is adopted, it should make it clear that the fail safe strength specified for remaining structure after the failure of a single principal structural element (§ 25.571 (c)) also applies to structure remaining after the occurrence of sonic fatigue cracking. It was the intent of the notice that the prescribed "probability" of catastrophic failure be determined under loads expected in service. The loads specified in § 25.571 (c)(1) through (c)(4) represent loads expected in service. This amendment therefore specifies the loads under which the prescribed improbability must be shown.

Two comments requested that the words "not probable", as used in the notice, be changed to "not possible" or "extremely remote probability." The words "not probable" are used in the present fail safe requirements in §§ 25.571 (c) and 25.573(c). This amendment is not intended to introduce a probability standard different from that administered under the present fail safe requirements. Therefore, these comments cannot be accepted.

One comment suggested that the proposal be changed to specifically include nonstructural parts such as fillets, fairings, and secondary structure near the sources of engine noise. Since the language in the notice covers all sonic fatigue sources of probable catastrophic failure, no further detail is necessary.

One comment suggested that this amendment be made retroactive to all turbojet powered airplanes now in service. If service experience reveals sonic fatigue effects in a given type of airplane, appropriate corrective action is available through the use of airworthiness directives. Beyond this, no further action, against airplanes now in service as a class, is necessary. Therefore, this comment cannot be accepted.

Interested persons have been afforded an opportunity to participate in the making of this regulation and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, Part 25 is hereby amended as follows, effective October 10, 1966.

(Secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423)

Amendment 25–11

Miscellaneous Aircraft Propulsion System Design Requirements

Adopted: April 28, 1967 **Effective: June 4, 1967**

(Published in 32 F.R. 6908, May 5, 1967)

This amendment adds miscellaneous changes to the propulsion system design requirements for airplanes and rotorcraft. This amendment is based on, and reflects public comments concerning, notice of proposed rule making 65–43, published in the FEDERAL REGISTER (31 F.R. 93) on January 5, 1966. Except as modified by the following discussion, the reasons for this amendment are those in the notice. Changes to the proposals in the notice, and disposition of public comments, are as follows:

The amendments to the combustion heater fire protection requirements of §§ 23.859, 25.859, 27.859, and 29.859 are drafted as proposed. One comment objected to the proposals for the following reasons: (1) The commentator states that this amendment would cause unnecessary expense and increase system complexity with a resultant reduction in reliability. The Administrator disagrees. This amendment merely clarifies the rules to reflect longstanding administration of the rules to require the appropriate shutoff device when any of the listed conditions occurs. Combustion heaters have been meeting this requirement for many years without evidence of unnecessary complexity or reduced reliability related to the requirement. This amendment makes no substantive change to this practice: (2) the commentator states that the words "and hold off" are present in Parts 23 and 27 but not in Parts 25 and 29, which indicates that an unnecessary burden may be involved in the case of nontransport category aircraft and should be deleted from Parts 23 and 27. The words "and hold off" are in the present rule. This amendment was intended to effect no substantive change. This comment therefore goes beyond the legitimate scope of the notice. However, the Administrator agrees that this comment may have merit. The comment will therefore be retained for possible rule-making action; (3) the commentator states that the rule should be clarified to allow the pilot to reenergize the heater after it has been shut off in flight, and to allow the use of one safety device to meet the rule with respect to all of the listed conditions requiring shutoff. The Administrator disagrees. This amendment, as written, does not prohibit re-energizing the heater during flight, nor does it prohibit the use of a single device that otherwise complies.

Another comment stated that long operating experience with combustion heaters does not indicate a need for "this sophisticated system." As stated above, no change in practice would result from this clarifying amendment. No change in required degree of sophistication is intended. The cited long operating experience was in fact obtained with systems which meet the rule as currently administered and as reflected in this amendment.

Proposed new §§ 23.906, 25.906, 27.906, and 29.906 are withdrawn. These proposed sections would have required the applicant for an aircraft type certificate to obtain, from the engine and propeller manufacturer, all vibration information that those manufacturers can supply to show compliance with the vibration requirements for aircraft. One industry comment stated that the proposed rule is unnecessary since § 21.21(b) requires, for an aircraft, that no feature or characteristic make it unsafe for the category in which certification is requested. Another industry comment stated that the proposal is not stringent enough. The FAA will continue in the future, as it has in the past, to administer § 21.21 (b) to require the use of engine and propeller vibration data to account for vibration conditions that result from the combination of specific engines, propellers, and airframes, where such investigation is necessary for safety. It is believed, however, that the possible kinds and sources of adequate vibration data are too numerous to be adequately covered in a specific, enforceable standard at this time.

The proposed change to § 23.907, deleting the reference to the propeller manufacturer, was based on proposed new § 23.906 which would have made that reference redundant. Since proposed § 23.906 is withdrawn, the proposed change to § 23.907 is not appropriate and is also withdrawn.

The notice proposed to amend § 25.933 to require that each turbojet reversing system must have means to prevent the engine from producing more than "idle forward thrust" when the reversing controls are set for reverse but the reversing system is not in the reverse position. Two comments stated that the limitation to "idle forward thrust" would impede reverser design unnecessarily and suggested that maintenance of directional control during reverser malfunction should be the only test for compliance. The administrator agrees that safety does not require a limitation to any specific thrust value if directional control can in fact be maintained. The approach recommended by industry is therefore allowed, by exception, in this amendment. However, in adopting the industry approach, it must be pointed out that safety requires that directional control capabilities be investigated under the most critical conditions expected in operation. Safety also requires that such control be maintained with aerodynamic means alone, since rapid diagnosis of a reverser malfunction, and timely correction by use of thrust controls, cannot be assumed when a reverser fails at the most critical condition. Dependence, even partial dependence, on other nonaerodynamic means of control such as differential use of brakes, is also not consistent with safety under the most critical conditions in which reverser malfunction could occur. Section 25.933 is drafted to reflect these factors.

The notice proposed to amend § 25.939 to require that operation of the airplane within the portion of the flight envelope that produces the "highest negative acceleration loads" may not cause hazardous malfunction of any part of the turbine powerplant, and to require that "the vibration characteristics" of turbine engine components whose failure could be catastrophic may not be "adversely affected" during normal operation. The notice also proposed to add new §§ 27.939 and 29.939 containing the requirements of § 25.959 in effect prior to this amendment plus the same negative acceleration and vibration requirements added to § 25.939.

One comment objected to the negative acceleration requirement for the following reasons: (1) The commentator states that the requirement involves engine design and may therefore be beyond the aircraft manufacturer's control. The Administrator does not agree that responsibility for proper operation of the turbine engine powerplant within the established flight envelope can be divided between the airplane and engine manufacturers during type certification of the airplane. Further, aircraft applicants have shown themselves capable of showing compliance with special conditions requiring that powerplant operation be safely maintained at vertical accelerations of less than zero g for specified lengths of time; (2) the commentator states that the requirement could be administered to require that the airplane be flown continuously to the negative limits of the maneuvering and gust envelopes for the airplane, whereas lesser negative acceleration loads may in fact be more critical from a fuel flow standpoint. The Administrator agrees with this comment. This result is not intended. The proposal is therefore amended to refer to "the negative acceleration * * * that is most critical from a fuel flow standpoint"; (3) the commentator states that substantiation of the fuel flow provisions under negative loads is not necessary because turbine engine powered airplanes either have continuous ignition or have systems that, when operated according to instructions in the Airplane Flight Manual, will provide ignition continuously during critical phases of takeoff, landing, icing conditions and in turbulence. The Administrator disagrees. While continuous ignition operation may broaden the range of fuel flow disturbances that can be tolerated without flameout, and is therefore significant from a safety standpoint, such ignition cannot prevent a flameout that results from fuel flow stoppage such as occurs when negative acceleration allows fuel ports to become uncovered. In such a case a restart cycle may be necessary. Instructions in the Airplane Flight Manual are no substitute for substantiation of the fuel system under negative loads; (4) the commentator states that long service experience shows that turbine engine fuel system components are not sensitive to negative acceleration loads, contrary to a statement in the preamble to the notice. The Administrator agrees in part. The sensitivity of the turbine fuel system to negative loads lies not in specific components, but rather in the sensitivity of the turbine engine to fuel flow stoppage, the high flow rates in the system, and the consequent speed with which air introduced into the system can reach the engine and result in flameout; (5) the commentator states that, while it is true that extended periods of negative acceleration may result in deterioration in performance due to interrupted flow, turbine engine fuel systems have been shown to be acceptable for the shorter exposure times actually encountered. The Administrator agrees. Investigation of the safety of turbine fuel systems under representative negative acceleration loads has long been required by special condition. This amendment therefore changes the proposal by adding the words "this must be shown for the greatest duration expected for that acceleration."

The commentator objected to the proposed vibration requirement, which affects Parts 25, 27, and 29, for the following reasons: (1) The commentator states that the proposal is unnecessary in Part 25, because of general § 25.601. The Administrator agrees that § 25.601 may be administered to cover specific vibration hazards. However, the Administrator's practice is to prescribe specific standards directly where such standards are in fact determined to be necessary for safety; (2) the commentator states that the proposal is unnecessary because vibration substantiation is already being done on a cooperative basis by industry. It is appreciated that vibration substantiations are already being accomplished. It should be noted, however, that special conditions have required such substantiation for more than a decade; (3) the commentator states that the proposal is too broad and, in the case of Parts 27 and 29, should be amended to refer to allowable vibration limits established by the engine manufacturer. The Administrator agrees. This amendment therefore covers only the turbine engine air inlet system, prohibits only harmful vibration resulting from air flow distortion, and covers normal operation only. This is consistent with special conditions applied over a large number of years. However, since there is no requirement that specific vibration limits (as opposed to values actually withstood during testing of the engine) be established by the engine manufacturer, the requested reference to allowable vibration limits established by the engine manufacturer is inappropriate and is not incorporated in this amendment.

One comment stated that the vibration standards should be similar to the more detailed standards in certain British Civil Airworthiness Requirements or, in the alternative, that similar material be placed in an Advisory Circular. While these suggestions go beyond the immediate scope of this amendment, they are appreciated and will be held for future reference.

The notice proposed to amend § 25.955 to require that turbine engine fuel systems "have means to automatically" ensure the uninterrupted flow of fuel to each turbine engine when the tank supplying that engine is depleted of fuel. One comment stated that the proposal should be limited to tanks which supply the engine in normal operation, and should not be applied to tanks that can supply the engine by cross feed. The Administrator agrees. This amendment thus uses the words "any other tank, that normally supplies fuel to that engine alone, * * *." One comment objected to the proposal, stating that the probability of an almost depleted tank in a single-tank-per-engine fuel system is very low. This amendment, however, applies only where another tank that normally supplies the engine contains usable fuel, which would not be the case in a single-tank-per-engine system. Another comment recommended that this amendment make it clear that manual switching capability is required. This comment is accepted. The proposal did not intend to eliminate present practice with respect to appropriate manual switching capability. A further comment objected to the proposal for the following reasons: (1) The commentator states that to require a "means" that is "automatic" strongly implies a sophisticated device that would introduce unnecessary hazards of its own. In order to prevent such an implication, this amendment more generally requires the fuel system design to "prevent interruption * * * without attention by the flight crew." No dictation of specific design or specific degree of complexity or sophistication is intended; (2) the commentator states that adequate fuel interruption warning is provided before flameout by fuel flow and pressure fluctuations, fuel pump low pressure warning lights, loss of rotor speed, reduction in EPR, and by fuel pressure and quantity instruments required by § 25.1305 (f) and (l). The Administrator disagrees. Considering the hazards of flameout outlined in the notice, experience has not shown that the monitoring of powerplant instruments provides a safe alternative to ensuring uninterrupted fuel flow without attention by the flight crew.

One comment objected to the proposal for the following reasons: (1) The commentator states that, to its knowledge, there has not been a problem with flameout caused by fuel interruption that indicates a need for automatic tank switching. Experience indicates that the hazard of flameout in turbine fuel system is severe enough to warrant requiring, as a minimum standard, that some design feature (not necessarily "switching" that is "automatic") be incorporated to ensure uninterrupted fuel flow without attention by the flight crew; (2) the commentator states that an automatic switching device would result in a relaxation of fuel monitoring due to reliance on the device. It is likely that overall fuel management would suffer. Further, monitoring of the fuel in the nearly depleted condition is not adequate, even if present. It is for this reason that this amendment is made. Finally, necessary monitoring of possible failures of the means for ensuring uninterrupted flow can be safely provided by proper procedures; (3) the commentator cites the hazards of malfunction of the automatic device and the impracticability of a sophisticated device. Existing manual switching, plus any necessary procedures for monitoring the device, will minimize any malfunction hazard when compared with the hazard of unexpected flameout. As mentioned above, this amendment does not specify any degree of complexity but only requires that appropriate "design features" be incorporated.

An editorial change is made to §§ 25.955 (b), 27.955(b) and 29.955(b) to correct an apparent departure from former §§ 4b.413(c), 6.420(c), and 7.413(c) of the Civil Air Regulations. These former sections contained the words "if an engine can be supplied with fuel from more than one tank." Sections 25.955(b), 27.955(b), and 29.955(b) shortened this language, without intentional change, to "if an engine can feed from more than one fuel tank." To preclude any questions concerning the applicability of the affected regulations, the language of the former sections is adopted without substantive change. There is no comparable problem in Part 23.

The notice proposed to amend § 25.961 to require that fuel system hot weather operating capability be shown up to the maximum operating altitude established as an operating limitation, and to limit the climb airspeed of turbine engine powered airplanes to that established for climbing to the maximum operating altitude. One comment stated that the proposal is not necessary for airplanes certificated for use with booster pumps that maintain the fuel system at a pressure greater than the vapor pressure of turbine fuels, up to the maximum operating altitude. The Administrator agrees. This amendment therefore excepts fuel systems having that capability, but is otherwise drafted as proposed.

The notice proposed to amend § 25.965 by replacing the present fuel tank vibration requirement based on a factor (0.9) related to engine speed with a requirement based on a specific vibration frequency (2,000 c.p.m.). One comment objected to this proposal on the ground that it appears to be a relaxation that would downgrade safety. The Administrator disagrees. This amendment, like its predecessor, applies only where no frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical. This amendment does not replace the survey of engine speeds conducted under § 25.965 (b)(3) (ii) and (iii) to determine that no critical condition is overlooked. For the purpose of the test covered by this amendment (that is, substantiation of the tank itself rather than substantiation of tank-engine combinations), a test frequency of 2,000 c.p.m., when imposed at the required test amplitude of 1/32 inch, has been shown to be severe enough to ensure the integrity of the tank itself. This comment cannot, therefore, be accepted. This amendment is drafted as proposed.

The notice proposed to amend § 25.969 to provide that an automatic shutoff must be provided, for pressure fueling systems, as the means of showing compliance with the current requirement that it must be impossible to fill the fuel tank expansion space inadvertently. One comment objected for the following reasons: The commentator states that this means of complying with present § 25.969 should not be limited to the proposed automatic shutoff device and that such a limitation would involve unnecessary dictation of design with respect to the means for preventing the filling of the expansion space. The Administrator agrees. For this reason, and to locate all pressure fueling provisions together, this amendment places the automatic fuel content limiting means requirement in § 25.979(b) and, to avoid unnecessary duplication, provides in § 25.969 (which is otherwise unchanged) that "for pressure fueling systems, compliance with this section may be shown with the means provided to comply with § 25.979 (b)"; the commentator states that the substance of the proposed change is already covered in § 25.979(b). The Administrator disagrees. This proposal, like § 25.969, covers only the limitation of fuel quantity. Section 25.979(b), however, covers protection from damaging overpressures that may result if (1) the fuel quantity limiting means fails, or (2) overpressures are transmitted, without "failure" of the fuel quantity limiting means, such as could occur, for example, where air in the tank does not escape under an abnormally high fueling source pressure (so that fuel quantity itself does not exceed "approved" limits) and the air then becomes part of the means by which overpressures are transmitted to the fuel system.

The notice proposed to amend the fuel tank outlet requirement of § 25.977 to require that fuel tank outlet strainers in turbine fuel systems be fine enough in mesh to prevent the passage of any object that could restrict fuel flow or damage any fuel system component, to require that an alternate means be provided in turbine fuel systems to provide uninterrupted fuel flow if the main strainer could become blocked with ice, and to require that this alternate means provide a level of fuel system component protection equal to that provided by the main strainer. One comment stated that the requirement that the main strainer prevent the passage of any object that could restrict fuel flow or damage components, if strictly interpreted, would lead to ice blockage of the means to prevent interruption of the fuel flow. The Administrator agrees. However, it is for this reason that the alternate means in § 25.977(b) was proposed. No change from the notice is necessary in this regard. The comment also states that a four-mesh screen of adequate size has been found to provide proper protection for the fuel system from a standpoint of both extraneous material and icing, and states that a four to eight mesh size should be prescribed specifically. The Administrator disagrees. No single mesh size, or single range of mesh sizes, has been shown to be adequate for turbine fuel systems generally. Another comment stated that it supports this amendment but that the prescribed alternate should not be a screen if another means of showing safety equal to the main strainer is available. This comment specifically mentions a pump inlet screen bypassing arrangement that might prevent pump damage. The Administrator agrees that the words "equal to" should not be administered to automatically exclude any available means of showing equal protection.

One comment stated that a second strainer is the only available alternative that is equal in safety to the main strainer, that safety would not be advanced by requiring a second strainer since both strainers could collect ice, that an actual need to protect against foreign matter in the tanks simultaneously with icing is not operationally probable, and that the rule should require a "high degree" of protection rather than protection "equal to" that of the main strainer. The Administrator disagrees. Means other than strainers are not precluded under this amendment if protection equal to the main strainer is shown.

The probability of simultaneous icing of an alternate strainer and the main strainer is slight enough to justify use of a strainer as an alternate. The words "high degree" of safety would not be appropriate since protection of the fuel system is best measured relative to the protection provided by the main strainer, which must be acceptable to the Administrator. These comments cannot, therefore, be accepted. This amendment is drafted as proposed.

The notice proposed to amend § 25.979 to cover all pressure refueling systems, to eliminate a reference to the fuel access cover plate, to more fully describe the means of preventing damaging overpressures, and to require that this means comply under the maximum fueling rates and pressures for which the system is designed. One comment objected for the following reasons: The commentator stated that the proposed detailed means of preventing damaging overpressures (that is, providing either proper tank vent sizing or an overflow valve) unduly dictates design. The Administrator agrees. This amendment therefore requires a means to prevent excessive pressures, without further prescribing the method of compliance (§ 25.979(c)). The commentator stated that the change to cover spillage from the "system" rather than from the "tank" would lead to added complexity without increased safety. The commentator appears to answer its own objection by then stating that highly reliable poppet check valves are commonly available to limit fuel spillage to nonhazardous amounts. No specific degree of complexity is intended or specified in this amendment. The commentator states that the proposal would preclude spillage of "minor" quantities of fuel from the refueling manifold. This comment is not understood, since the proposal concerns only "hazardous" quantities of spilled fuel. The commentator stated that the prohibition of spillage is inconsistent with the fact that large quantities of fuel may be spilled in order to comply with the proposed pressure relief requirement (proposed § 25.979(b)). The Administrator disagrees. The pressure relief provisions specifically apply only to conditions following failure of the prescribed fuel quantity limiting means. Thus, the fuel spillage resulting from pressure relief is tolerated only as a necessary means of preventing a significantly greater hazard, such as structural damage to the airframe which may not be detected before flight, and is tolerated only as a consequence of pressure relief requirements prescribed as a backup to the fuel quantity limiting means. The commentator suggested wording that would limit the fuel spillage requirement to "uncontrolled quantities." Since hazardous quantities may or may not be "controlled" in some way, the requested language would not be useful in preventing a hazardous situation and therefore cannot be adopted. This part of the amendment is therefore drafted as proposed (§ 25.979(a)). Section 25.979(b) contains the required automatic shutoff means for limiting tank content that was proposed as part of § 25.969. This means is placed in § 25.979, rather than § 25.969 as proposed, for the reasons covered in the discussion of § 25.969 (see above).

The notice proposed a new § 25.981 containing certain fuel system lightning protection requirements. In order not to delay the issue of the numerous rule changes of this amendment, action on this proposal will be taken separately. The final rule on lightning protection is now in the process of being prepared and will be issued shortly.

The notice proposed to add a new § 25.1003 providing that no temperature inside any fuel tank may exceed a specified temperature and requiring that compliance be shown for all normal and abnormal operations of all components that are inside any tank or that could transmit heat to any tank, including all possible malfunctions of those components. This amendment adds a new § 25.981, rather than § 25.1003, since this amendment affects fuel tanks only (rather than fuel systems). One comment stated that substantiation for all "possible" malfunctions and "combination of malfunctions" would be unduly difficult. The Administrator agrees. This amendment specifies only "probable * * * conditions." The comment also stated that specification of a temperature limit to cover all present and future fuels and conditions is undesirable. The Administrator agrees. This amendment therefore incorporates only "the highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the tanks." Another comment requested that the proposal be eliminated because future design improvements and fuel requirements would require different maximum fuel temperatures. This amendment meets this objection by requiring prevention of fuel autoignition without prescribing a universal maximum temperature.

The notice proposed to amend § 25.1041 to require adequate cooling not only when the airplane is operating but also "after engine shutdown." One comment stated that there may be abnormal engine shutdowns, such as an emergency shutdown from a high power setting, following which temperature limits may be exceeded. This comment stated that the proposal should be narrowed to include only "normal" engine shutdowns. The Administrator agrees. This amendment is so drafted.

The notice proposed to amend § 25.1141 to require that no probable failure or "combination of failures" in any powerplant control system may cause the failure of any function necessary for safety, and that compliance must be shown by "fault analysis, component tests, and simulated environmental tests." One comment objected to the proposal because (1) "combination of failures" is contrary to the basic philosophy that the airplane need only be capable of continued safe flight and landing after a single failure, and (2) compliance with the requirement should not be required to be by "fault analysis, component tests and simulated environmental tests" since accepted practice is to use fault analysis alone unless tests are necessary to substantiate the validity of a particular analytical result. The Administrator does not agree with the first statement. It is not the policy of the Administrator to ignore a probable combination of failures whose result would be hazardous. The Administrator does, however, agree with the second statement. A combination of means of showing compliance is therefore permitted under this amendment. In addition, two changes to the notice are made to more accurately express its intent. First, the prescribed failed "function" is limited to "powerplant function." Secondly, the words "failures or combination of failures" in the system is changed to include "malfunctions." The notice did not intend to raise a technical or semantic distinction between a powerplant control system "failure" and "malfunction" where their common result is discontinuance of an essential powerplant function.

The notice proposed to amend § 25.1153(b) to require only that "inadvertent" movement of the propeller control to the feathering position be prevented (rather than positive prevention of such movement as the rule currently required). One comment objected to this change as an undesirable relaxation. The Administrator disagrees. The present rules for propeller feathering controls generally (in § 25.1153(a)) and for reverse thrust controls (in § 25.1155) cover only "inadvertent" control operation. No higher standard has been shown to be necessary for propeller pitch or speed controls used for feathering. This amendment is drafted as proposed.

The notice proposed to broaden § 25.1155 to cover controls for propeller pitch settings below the flight regime, not just reverse thrust controls. One comment stated that the degree of complexity of such controls in a certain currently operational aircraft should not be exceeded in the administration of this amendment. This amendment is not intended to dictate any specific degree of complexity. Another comment objected, stating that this amendment relaxes the present rule by using the word "inadvertent." No relaxation results. The word "inadvertent" is used in the present rule. This amendment in fact increases a burden by extending § 25.1155 to cover controls heretofore not covered by the regulations. This amendment is drafted as proposed.

The notice proposed to delete § 25.1181 (c) and place its provisions, with certain amendments, in a new § 25.1182. One comment objected, stating that the fire protection requirements applicable to nacelle areas behind firewalls need not be extended to engine pod attaching structures because the present requirements have provided a superior level of safety for turbojet powered large airplanes and no record of fires in these structures is known. The Administrator agrees concerning the superior level of safety and good service record of engine pod attaching structures with respect to fire. However, this level of safety has resulted through the voluntary incorporation by industry of engine pod attaching structure design provisions meeting the fire protection provisions of §§ 25.1195 through 25.1201 (except those requiring fire detection and extinguishing). The Administrator agrees with one comment stating that safety does not require that engine pod attaching structures have fire detection and extinguishing provisions, and that those structures may be distinguished from nacelle areas behind the firewall in this regard. To this extent, the industry comment is accepted and this amendment is drafted accordingly. The commentator stated that the "firewall definition" paragraphs are not relevant for the fire zone, that the "internal boundaries" are not clearly defined, and that this will lead to ventilation, containment, and fire extinguishing system difficulties. The intent of this comment is not clear. However, there should be no difficulty in defining the area covered by the term "engine pod attaching structure." Further, the Administrator does not agree that the firewall provisions are irrelevant to this structure. For this structure, as well as for reciprocating engine installations, the firewall separates the engine nacelle from the airframe in compliance with the provisions of § 25.1191. Finally, the claimed relationship between the firewall defining provisions and possible future difficulties in ventilation, containment, and fire extinguishing is neither supported nor evident. This comment cannot, therefore, be accepted.

One comment requested that an exception should be provided (1) for engine pod attaching structures where the firewall between pod and pylon extends enough beyond the profile of the pylon to prevent propagation of fire from the pod area around the firewall to the pylon zone, and (2) for installations that have means to prevent contact of leaking flammable fluid with a hot firewall. The Administrator agrees that these safety provisions may be relevant in individual showings of equivalent safety that may justify design alternatives to the sections referenced in § 25.1182. However, within the terms framed by the commentator, these safety provisions are not sufficiently definable to permit a general exception in the regulation. This comment cannot, therefore, be accepted.

No adverse comments having been received, the proposed change to §§ 23.1183, 25.1183, 27.1183, and 29.1183 (concerning lines and fittings approved as part of an engine) is drafted as proposed.

The notice proposed to add a new § 25.1305(x) to require "a means, for each air turbine engine starter not designed for continuous use, to indicate to the flight crew when that starter is energized." One comment stated that, for starters designed to contain failures of high energy rotating parts, no indicator should be required because no hazard would result even if the starter is not designed for continuous operation. Another comment stated that numerous possible factors, such as use of starters that cannot be used continuously, protection by starter location, and containment of failed components should obviate the need for an indicating means regardless of whether the starter is designed for continued operation. The Administrator agrees with these comments. This amendment therefore covers only starters that can be used continuously but that are neither designed for continuous operation nor designed to prevent hazard if they fail.

No adverse comments having been received, the proposed amendment to §§ 23.1585, 25.1585, 27.1585, and 29.1585 (concerning fuel system operating procedures) is drafted as proposed.

In consideration of the foregoing, Subchapter C of Chapter I of Title 14 of the Code of Federal Regulations is amended, effective June 4, 1967.

(Secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423)

Amendment 25-12

Altimeter System Requirements

Adopted: May 16, 1967 **Effective: August 1, 1967**

(Published in 32 F.R. 7584, May 24, 1967)

The purpose of this amendment to Parts 23, 25, 43, and 91 of the Federal Aviation Regulations is to revise the design standards concerning static pressure systems and to revise the test requirements applicable to the maintenance of altimeter systems.

This amendment is based on a notice of proposed rule making (Notice No. 66-44) published in the Federal Register on December 31, 1966 (31 F.R. 16790).

Numerous comments were received in response to Notice 66-44, most of which were in agreement with the proposal. The more pertinent of the comments that raised questions together with the changes in the proposal resulting therefrom are discussed hereinafter.

With reference to the static pressure system proof test required under both

Part 23 and Part 25, an inconsistency in wording was noted in regard to the pressure differential at which the tests are run for unpressurized aircraft. Since there is no reason for different requirements, § 25.1325(c)(2)(i) has been modified to require a pressure differential of approximately 1 inch of mercury rather than the absolute value of 1 inch as stated in the notice.

One commentator pointed out that the requirement that the proof tests of the static pressure systems on unpressurized aircraft be conducted with the static pressure system evacuated to a pressure differential based on an altimeter reading of 1,000 feet at sea level could be confusing to people located at elevations above 1,000 feet mean sea level. The FAA agrees and §§ 23.1325(b)(2)(i) and 25.1325(c)(2)(i) have been further amended to permit the proof test of unpressurized aircraft with the static pressure system evacuated to an altimeter reading of 1,000 feet above the airplane elevation at the time of the test.

It was recommended that § 25.1325(c)(2)(ii) be changed in its entirety to provide a new leak test tolerance formula that would reduce test ambiguities resulting from calculating the 2 percent tolerance using pounds per square inch or feet altitude at different airport elevations. In this connection, the FAA previously investigated the feasibility of establishing a quantitative static system test. That investigation, however, indicated that a quantitative test was much too complex for general use but that the simplified qualitative test would be satisfactory and would provide adequate results without any adverse effect on safety. The latter was accordingly proposed in the notice. In the interest of simplicity and ease of performance, the FAA is retaining the test references in terms of feet altitude even though this qualitative approach may give minor differences in test results where the tests are run at different field elevations.

One commentator stated that the proposed § 23.1325(b)(3) requirement for a correction card where altimeter readings on primary and alternate static systems differ by more than 50 feet, is too restrictive at high altitudes and high Mach numbers and suggested clarification as to the range of altitude and Mach numbers applying to this tolerance. However, the FAA believes that the proposed requirement is necessary to assure proper vertical separation considering the entire altitude-speed range. In the high Mach—high altitude regime, the static system accuracy may be marginal at best and errors introduced while on the alternate system could lead to hazardous operation if the pilot is not informed of the magnitude of the error. In the low speed—low altitude regime, static system errors are minimized so that correspondence between the two systems should pose no problem.

As noted by one commentator, the first altitude entry in Table I, Appendix E, Part 43, was inadvertently printed as 1,000 feet when it should have been −1,000. The table has been corrected accordingly.

One of the comments contained a recommendation that section (c) of Appendix E should be changed to require recording of date and test altitude on the altimeter dial. The FAA does not, however, agree with the recommended change. Such a requirement would result in the unnecessary cluttering of the instrument face and unnecessary expense and inconvenience due to instrument removal and teardown in order to record the information on subsequent inspections. The requirement that the date and maximum altitude to which the altimeter has been tested be recorded on the altimeter, is necessary to provide the information for entry in the airplane log or other permanent record when the instrument is installed in an airplane. With the maximum altitude for the altimeter entered in the aircraft log, there is no need, insofar as the pilot is concerned, to enter that data on the face of the instrument.

In connection with the altimeter test and inspection, comments variously suggested the importance of preliminary pitot system checks to preclude damage to the airspeed meter, of periodic purging of pitot and static lines, and of information concerning the accuracy of altimeter test equipment. The FAA sees merit in these comments, and contemplates that to the extent that it has not already been accomplished, such information will be presented as acceptable means of compliance with the proposed rules in appropriate advisory circulars.

One commentator suggested changes to section (c) of Appendix E to eliminate the requirement for commercial operators to prepare records under § 43.9 in addition to those they presently keep. Commercial operators of large aircraft maintained in accordance with a continuous airworthiness program under Part 121 are exempted from the requirements of § 91.170 by the provisions of § 91.161. Therefore, there is no need for the recommended change insofar as such operators are concerned. On the other hand, commercial operators of small aircraft are governed by Part 135 of the FARs and they are not required to maintain their aircraft under a continuous airworthiness program. The provisions of present § 43.9(a) apply to such operators and they would not, by the proposed rule, be required to prepare records in addition to those they presently keep. The recommended change, is, therefore, unnecessary.

Expressing the belief that the proposed regulations would require periodic removal of the altimeter instruments for the required tests and inspections, one comment indicated that extensive work behind the instrument panel can cause malfunctions of other equipment disturbed in the process. For this reason, the comment suggested that there should be an amendment to allow airframe repair stations to use external connections to test the static system and the altimeter using a reference altimeter that is calibrated against a master semiannually. The FAA presently permits the use of external connections to test the static and altimeter systems. However, the advisory circular covering this matter suggests that the reference altimeter be calibrated once each month until the necessary interval between calibration checks can be determined. Using this procedure, it may be that the accuracy of the reference altimeter can be maintained by a semiannual calibration.

The proposal has not been revised in accordance with the recommendation that altimeters and static systems be tested and inspected once each year instead of each 24 months. Based on current experience as reported by major altimeter manufacturers and repair stations, the FAA has determined that an altimeter instrument and static system will maintain accuracy and integrity for 2 years following a test and inspection. To require yearly tests of either or both systems would impose a burden on owners and operators without a corresponding increase in safety.

Numerous comments were received concerning the persons authorized to perform the tests and inspections of the static pressure system and the altimeter instrument. One comment suggested that the designation should have included noncertificated repair stations and fixed base operators. In this connection, it should be pointed out that the static pressure system and altimeter instrument tests and inspections are maintenance items and must, therefore, be performed by persons certificated to perform maintenance. Moreover, the tests and inspections require sophisticated test equipment and a capability that must be maintained under a system of periodic inspections. It is only through the certification procedures that the FAA is able to regularly conduct surveillance of the approved facilities and make periodic determinations as to their capability. Another comment suggested that a certificated "A & P" mechanic should be permitted to conduct the necessary tests and inspections. The FAA agrees with this comment insofar as the static pressure system tests are concerned and the regulation has been so revised. However, the FAA does not consider that it would be appropriate to authorize certificated mechanics to conduct the required altimeter tests and inspections in the light of the test equipment and capability that is necessary for those tests and inspections. The opinion was also expressed that the proposal would permit certificated repair stations with airframe ratings to accomplish an instrument major repair without the necessity of obtaining an instrument rating. As proposed, the rule permits a repair station having an airframe rating to conduct the tests and inspections necessary for the altimeter instrument. However, the rule does not permit repair stations with only an airframe rating to accomplish any repairs to the instrument. Contrary to the understanding of this commentator, the altimeter tests covered under this proposal are not considered to be major repairs to the altimeter. Finally, the FAA does not concur with the recommendation that the provision designating the persons authorized to conduct the required inspections and tests be deleted from § 91.170 and added to Appendix E in Part 43. While it is true that Appendix E contains the scope of the required inspections and tests that the designated persons are authorized to conduct, the FAA considers that from the standpoint of the owner or operator of an airplane, it would be better to set forth the designation in the operating requirements of Part 91 rather than as part of the technical details of the inspections and tests in the Appendix to Part 43.

The present requirements of § 91.170 apply only to persons operating an airplane in controlled airspace under IFR.

The phrase "in controlled airspace," which limits the applicability of § 91.170, was incorporated into the regulation after consideration by the Agency in an appropriate rule-making action. However, a comment has now been received in response to Notice 66-44 requesting the FAA to delete the phrase "in controlled airspace" on the ground that a substantial number of IFR flights are made within uncontrolled airspace and that there is no reason why the altimetry maintenance and alteration standards should not apply to IFR flight in both controlled and uncontrolled airspace. While this comment involves a substantive change to the present requirements that goes beyond the scope of this notice of proposed rule making, the FAA believes that it warrants further consideration in connection with other altitude indication projects now in process.

Interested persons have been afforded an opportunity to participate in the making of this amendment, and due consideration has been given to all matter presented.

In consideration of the foregoing, Parts 23, 25, 43, and 91 of the Federal Aviation Regulations are amended effective August 1, 1967.

(Secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423)

Amendment 25-13

Hydraulic System for Transport Category Airplanes

Adopted: June 21, 1967 **Effective: July 27, 1967**

(Published in 32 F.R. 9152, June 28, 1967)

The purpose of this amendment to § 25.1435 of the Federal Aviation Regulations is to prescribe more comprehensive design and test requirements for transport category airplane hydraulic systems.

This amendment is based on a notice of proposed rule making (Notice No. 65-33), published in the Federal Register on November 5, 1965, (30 F.R. 14015).

Numerous comments were received in response to Notice 65-33. The more pertinent of these comments, together with the changes in the proposal resulting therefrom are discussed hereinafter.

One comment recommended that, in order to be consistent with normal design practices, each element of the hydraulic system should withstand, without rupture, the ultimate pressure loads (design operating pressure loads multiplied by a factor of safety of 1.5) in combination with ultimate structural loads that can reasonably occur simultaneously. The proposal would have required consideration of design operating pressure loads in combination with ultimate structural loads in all cases, with no regard as to whether the two would ever occur simultaneously in service. The FAA agrees with this comment since the establishment of ultimate pressure is in accord with other provisions in the regulation, and the application of ultimate pressure loads and ultimate structural loads only when the combination can reasonably occur to cause rupture, is more rational and less burdensome than the proposal.

A number of comments objected to the use of the terms "main" and "primary" in describing the hydraulic power systems in proposed § 25.1435(a) (2), (3) and (4). The FAA agrees that the words "primary" and "main" can be confusing and that the proposal should be clarified in this regard. However, the FAA does not agree with the comment that the rule should require pressure indication in each "standby system". In this connection, the proposal has been changed to make it clear that pressure indication is necessary only in continuously operating systems.

Numerous comments suggested that the pressure indication means should be gages, or warning lights, or both. However, the FAA does not consider that it is necessary to specify the means. While either a gage or a light would be satisfactory, the applicant should be allowed to show that some other means is also adequate.

There was a comment to the effect that fluid quantity indication should be mandatory for each system having a reservoir. On the other hand, another comment stated that a minimum airworthiness standard should not require any fluid quantity indication, and that the pressure indication was sufficient. The FAA does not agree with either of these comments. A fluid quantity indication means could not be justified for certain emergency standby systems which have small reservoirs. However, based on service experience, the FAA considers that there is ample justification for the proposed fluid quantity indication requirement. In the light of these comments the proposed requirement concerning the fluid quantity indication means has been changed to make it clear that a means must be provided at a flight crewmember station to indicate the quantity of fluid in each continuously operating system. The FAA agrees with a final comment that there is no reasonable correlation between quantity indication and four separate ways of serving any fundamental function as suggested in proposed § 25.1435 (a)(3) and the proposed exception to the fluid indication requirement has been deleted.

There were a large number of comments objecting to the requirement for a fluid temperature indication as set forth in § 25.1435(a)(4). After further consideration in the light of the comments received, the FAA has concluded that there is no present need for the proposed temperature indication requirement and the proposal has been deleted accordingly.

While concurring with the proposed requirements of § 25.1435(a)(5), one commentator suggested a limit of 125 percent of design operating pressure for the hydraulic system generally, and plus or minus 10 percent pump ripple pressures. Another comment said that the standard should require that power supplied (pumps) and operation of actuators must not produce surges or frequencies which are destructive to any part of the system. Finally, it was recommended that the requirement should minimize surge pressure effect in all components in the hydraulic system. The FAA agrees with these comments but considers that the regulations as proposed will accomplish the stated objective. The FAA also sees merit in establishing specific overpressure limits as suggested. However, it is not in a position at this time to specify the limit values and further study will be required before a proposal in this matter can be made.

In response to a comment with respect to the proposed requirements in § 25.1435(a)(6) that each hydraulic element must be protected from abrasion, corrosion, and mechanical damage, the FAA agrees that such a requirement is too restrictive and should be changed to take into consideration damage which must be expected during normal service life. Furthermore, the FAA agrees that the requirement concerning harmful or hazardous concentrations of hydraulic fluid or vapor should be revised to apply only during flight. However, the FAA does not agree with a request that the terms "harmful" and "hazardous" be defined. The FAA considers that since each individual application must be evaluated to determine whether there is a harmful or hazardous condition present and since such an evaluation depends on, among other things, the fluid used, system pressure, and emergency procedures available to the crew, a definition that would be uniformly applicable is not possible.

One of the comments recommended that the proposed § 25.1435(a)(6) be further amended to require that routing of hydraulic lines in exposed areas be designed to afford maximum protection from foreign object damage such as objects thrown by the wheels. In this regard, however, we believe that since the regulation requires that each hydraulic element must be installed to present excessive vibration, abrasion, corrosion, and mechanical damage, it is sufficiently broad to cover all physical damage regardless of cause. It is considered, therefore, that further amendment as suggested would merely emphasize a specific source of damage already included within the objectively stated rule.

In response to numerous objections to the burst test pressure requirements in proposed § 25.1435(b)(1), the FAA has determined that the proposal should be deleted. In consideration of other provisions of the regulation, the FAA agrees that the proposed burst test pressures could result in a substantial weight and cost penalty with no certainty of improvement in reliability.

In commenting on § 25.1435(b)(2), several persons suggested that the rule should be amended to make it clear that it applies to type certification only. However, the FAA does not believe that such a revision is necessary since the applicability provision of Part 25 specifically states that the standards set forth therein are the airworthiness standards for the issue of and changes to type certification. Another comment stated that this rule should apply only to installed tubing. However, the FAA intends that the requirement be applied to the complete system installed in an airplane and not just to tubing and the current rule was revised in the proposal to make this clear. However, in response to comments, the FAA does agree that the proposed regulation should be changed to make it clear that during the static tests there must be adequate clearance between structural members and hydraulic system components and that following the tests there must be no permanent detrimental deformation. The rule has been amended accordingly and renumbered as § 25.1435(b)(1).

The current fire protection requirements for hydraulic systems set forth in § 25.1435(c) merely require compliance with other sections of Part 25. In Notice 65-33, the FAA expressly determined that paragraph (c) should be amended to include the substance of the referenced sections and to delete all reference to the word "flammable." However, comments received concerning the fire protection requirements have persuaded the FAA to retain paragraph (c) in its present form. Thus, paragraph (c) remains applicable only to hydraulic systems using flammable fluids. The following is a discussion of the comments received with respect to the proposed requirements insofar as they relate to the requirements of the final rule.

With respect to the requirements concerning fire protection set forth in proposed § 25.1435(c)(1), a comment suggested that the requirements should require detection as well as control of any fire resulting from the ignition of hydraulic fluids. In addition, a suggestion was made that the rule should require the use of fire resistant fluids. Control of a fire does not necessarily require detection. In some cases, control is inherent in the design through fireproof construction or the sealing off of ventilation. In other cases, however, control of a fire may entail detection. The requirement for control of a fire is intended to assure that all the steps necessary to control the fire in the particular case are provided, including detection where needed. Furthermore, the FAA does not believe that a requirement for fire resistant hydraulic fluids is necessary. The substantial service experience available for hydraulic fluids indicates that oil-base hydraulic fluids are safe when adequate fire protection is also provided.

Concerning the requirements of proposed § 25.1435(c)(2), a suggestion was made that the location of the hydraulic fluid reservoir should not be permitted in any designated fire zone. The FAA does not agree with this suggestion. There has been no adverse service experience with flammable fluid reservoirs to indicate that a requirement prohibiting the installation of a hydraulic fluid reservoir in a designated fire zone is necessary.

A comment concerning the requirement in proposed § 25.1435(c)(3) that at least a ½-inch clearance must be provided between tank or reservoir and firewalls or shrouds, suggested that the requirement should be more general and should be tied to the ambient temperature or to the heat transmitting characteristics of the firewall or shroud. The FAA, however, does not believe it necessary to change this requirement. The requirement specifies that there must be at least a ½-inch clearance and this does not preclude requiring a larger clearance if type certification evaluation indicates that additional clearance is necessary. In this connection, the functional tests, endurance tests, and analyses required under amended § 25.1435(b)(2) may justify imposition of a greater clearance.

Concerning the proposed requirements of § 25.1435(c)(5), certain comments indicated that the shutoff means required should be a shutoff valve while another comment stated that a shutoff means is not needed where tests prove the fluid transportation system and equipment is fire-resistant equivalent to the aircraft structure. The FAA, however, does not believe that the rule should specifically require a shutoff valve but should permit the use of any means to prevent hydraulic fluid from entering a designated fire zone. Moreover, the FAA must also reject the recommendation to allow elimination of the shutoff means on a showing that the fluid transportation system is fire-resistant, equivalent to the aircraft structure. The FAA does not consider that, in the event of fire, the unrestricted flow of flammable fluid within a designed fire zone, even though transported in a fire-resistant system, provides the same level of safety as preventing such flow by a shutoff means.

Comments received objecting to the proposed new § 25.1435(c)(6) indicated that the requirement should reference the remaining parts of the system, rather than only the parts of the system associated with other designated fire zones. The FAA agrees with this comment, and, by retaining the present paragraph (c) which contains the appropriate references, has incorporated it into the regulations.

With respect to the proposed requirement of § 25.1435(c)(9), a comment stated that it should require that the amount of plumbing between a shutoff valve and the fire zone be kept to a minimum. The FAA does not agree with this comment. There was no data submitted in support of this recommendation and in the FAA's opinion, keeping the plumbing between the shutoff valve and the fire zone to an undefined "minimum" would not, in all cases, prevent hazardous quantities of fluid from draining into that fire zone. Therefore, the FAA does not consider that a requirement along the lines suggested by this comment is necessary in the interest of safety.

A comment concerning the requirements of proposed § 25.1435(c)(11) noted that the flexible hose assembly must be approved and asked by whom the hose is to be approved. Other comments suggested the need to define "fire resistant" and pointed out that the rule should make it clear that insofar as the fire resistant requirement is concerned, the word "line" includes flexible hose assemblies. By "approved" flexible hose assembly, the FAA means any assembly approved in a manner specified in § 21.305 of the FARs. Moreover, since the term "fire resistant" is already defined in Part 1 of the FARs and since that definition applies to the term as used in this regulation, there is no need for a definition in this rule. Finally, it should be pointed out that the fire protection requirements have not been adopted in the form proposed. In this final amendment, the fire protection requirements are the same as presently set forth in the regulations. In this connection, the regulation, as presently drafted, includes flexible hose assemblies under the general heading of lines and fittings and such assemblies have been consistently treated as lines and fittings under that requirement. Therefore, the FAA does not believe that clarification of the requirement is necessary.

In response to numerous objections to proposed § 25.1435(d), *Reliability*, the FAA has deleted requirements relating to environmental testing of the assembled system and set forth the remaining portions of proposed paragraph (d) in a new paragraph (b)(2). In this connection, the FAA agrees that the proposed environmental testing of the assembled system is not necessary in order to achieve a reasonable and effective testing program for improving hydraulic system reliability, and the final rule has been changed accordingly. Moreover, the FAA determined that the specific requirements continued in proposed paragraphs (d)(2) and (d)(3), which stated endurance testing requirements were unnecessarily detailed. The endurance testing requirements have been revised to specify a more objective standard and as set forth in the new paragraph (b)(2) requires that endurance tests must simulate the repeated complete flights that could be expected to occur in service. In addition, based on numerous comments, the proposal has been relaxed to the extent that cyclic loads during the tests need not take into account the effects of vibration and variations in temperature. Finally, as pointed out by the comments, elements which have failed during testing may need only to be modified and not redesigned and the rule has been changed accordingly.

A comment recommended that filters be required at strategic points in the system so that contaminants from a failed component will not travel through the system. The FAA does not agree with the recommendation. Extra filters add to the weight and complexity of hydraulic systems and could, therefore, conceivably reduce the overall reliability of the system. Removal of contaminants following a component failure is accomplished by proper maintenance procedures which vary with hydraulic system design. The comment presents no justification for such a requirement and the FAA is not aware of any unsatisfactory service experience in this area. Therefore, the FAA does not believe that such a requirement is necessary in the interest of safety.

In response to a recommendation that the standard require all components to be designed so that they cannot be installed incorrectly it should be noted that such a requirement would impose an unwarranted design burden on the manufacturers since, in all cases, subsequent installation of the components is required to be made by trained personnel.

A comment was received suggesting that the rule should include a requirement that the normal system be provided with a reserve fluid supply. However, the FAA is aware that hydraulic failures, when they occur, are such that loss of fluid is rapid. The introduction of more fluid into the system would be of no value since the new fluid would be lost before pressure could be restored in the system.

Interested persons have been afforded an opportunity to participate in the making of this amendment, and due consideration has been given to all matter presented.

This amendment is made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423).

In consideration of the foregoing, § 25.1435 of Part 25 of the Federal Aviation Regulations is amended, effective July 27, 1967.

Amendment 25–14

Fuel System Lightning Protection

Adopted: August 7, 1967 **Effective: September 10, 1967**

(Published in 32 F.R. 11629, August 11, 1967)

This amendment adds fuel system lightning protection design requirements for transport category airplanes. This amendment is based on, and reflects public comments concerning, item 11 of notice of proposed rule making 65–43, published in the FEDERAL REGISTER (31 F.R. 93) on January 5, 1966. (Rules based on the remainder of the items proposed in Notice 65–43 were published as miscellaneous Aircraft Propulsion System Design Requirements in 32 F.R. 6908 on May 5, 1967.)

Public comments generally agreed that fuel system lightning protection should be given design consideration. The only objections submitted concerned the degree of detail in the proposed regulation. One comment stated that the proposal was too general, was overly open to interpretation, and should be withheld until more detailed criteria are prepared. One comment took the opposite approach, stating that the proposal was too detailed and too closely tied to current knowledge of the effects of lightning on aircraft. The FAA agrees with the latter comment. While it is recognized that any general regulation requires that certain details be supplied by administration, it is believed that such flexibility is necessary and desirable in this case. The current state of knowledge concerning the protection of aircraft from lightning is expanding rapidly. Further, the need for lightning protection is too widely established to be treated only by special conditions in individual cases. The FAA therefore believes that the best course of action is to prescribe the basic design objectives contained in the notice—which include protection from direct lightning strikes, swept lightning strokes, and corona and streamering—and administer these design objectives to reflect current progress in lightning protection techniques.

With respect to swept strokes, the notice covered each area of the airplane in which they "may occur." However, with respect to direct strikes, the notice covered only areas where there is a "high probability" of stroke attachment. A swept stroke is in fact a series of successive direct strikes swept across the surface of the airplane by the motion of the airplane. The probabilities of these two kinds of events are thus closely related. It was not the intent of the notice to require investigation of swept strokes other than those associated with the direct strikes that are covered, namely those in the areas of high probability of stroke attachment. For this reason, this amendment refers only to swept strokes in areas where they are "highly probable."

One comment requested that the FAA look closely to continuing research for new solutions to lightning hazards, and that the possibility of inerting the airspace in the tanks be considered. The FAA agrees, and will administer this amendment to give full consideration to any solutions that research and experience show to be feasible and effective in meeting the complex hazards of lightning and its associated phenomena.

The notice proposed a new § 25.981. However, since this amendment is general in nature, it is more appropriate to add a new § 25.954. This is done.

Interested persons have been afforded an opportunity to participate in the making of this amendment. All relevant matter submitted has been fully considered.

In consideration of the foregoing, Part 25 of Subchapter C of Chapter I of Title 14 of the Code of Federal Regulations is hereby amended, effective September 10, 1967, by adding a new § 25.954.

(Secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423)

Amendment 25-15

Crashworthiness and Passenger Evacuation Standards; Transport Category Airplanes

Adopted: September 15, 1967 **Effective: October 24, 1967**

(Published in 32 F.R. 13255, September 20, 1967)

The purpose of these amendments is to improve the emergency evacuation equipment requirements and operating procedures for transport category airplanes.

These amendments are based on a notice of proposed rule making (31 F.R. 10275, July 29, 1966), circulated as Notice No. 66-26 dated July 26, 1966, and on a supplement to notice of proposed rule making (31 F.R. 11725, Sept. 7, 1966), circulated as Notice No. 66-26A dated September 2, 1966.

Numerous comments were received in response to Notice 66-26 and supplemental Notice 66-26A. Based upon these comments and upon review within the FAA, a number of changes have been made to the proposed rule. Most of these changes involve rewording and reorganization for greater clarity and consistency. However, certain substantive changes have been made to the proposed regulation that do not require compliance for periods of from 1 to 2 years. While all but a few of these changes fall within the scope of Notices 66-26 and 66-26A, interested persons have not been given the opportunity to comment on the details of the requirements. The issuance of a supplemental notice of proposed rule making to solicit comments upon these was considered. However, comments from the public on the original notices and from within the FAA indicated that the further delays attendant to this course of action would not be in the best interest of those concerned. Consequently, the FAA is issuing a final rule to allow the persons affected by these regulations to proceed with the certification or retrofitting of their airplanes without further delay.

Thereafter, the FAA will consider comments on the changes referred to above received from interested persons on or before October 24, 1967, and may further amend the regulations in the light of these comments. The FAA believes that this course of action is justified and is in the best interest of the public.

The amendments incorporated herein are aimed at increasing substantially the probability of occupant survival in an aircraft accident. The FAA will consider additional revisions of the regulations, as advances in the state-of-the-art allow, in order to further increase that probability of survival. To this end, Government and industry development programs have been established to devise new techniques, designs, and equipment. In progress now are developments on: More effective self-extinguishing characteristics for aircraft interior materials; cabin fire suppressant systems; protection from smoke and fumes; gelled fuels; improved emergency lighting and exit conspicuity; and improved evacuation facilities and techniques.

The final amendments and the more pertinent of the comments received in response to the notices are set forth hereinafter.

PART 21

Sections 21.17 and 21.101 are amended as proposed to accommodate the special retroactive requirements incorporated by new § 25.2.

PART 25

Section 25.2. Of key importance in the notice was the provision relating to retroactivity. Proposed § 25.2 covered special requirements applicable to type certificates and to supplemental type certificates (or amended type certificates) involving increases in passenger seating capacity. There were numerous comments received with respect to this section as proposed and certain of the recommended changes have been adopted.

We agree with one recommendation that § 25.2 be changed to clarify the intent that insofar as supplemental type certificates and amendments to type certificates are concerned, the special requirements are applicable only when there is an increase in passenger seating capacity beyond that already approved under the terms of the basic type certificate. Section 25.2 has been amended accordingly.

The preamble to Notice 66-26 explained the intent to make all the proposed regulatory items applicable to airplanes for which an application for a type certificate is made after the effective date of the amendments and to airplanes for which type certificates are issued after the effective date irrespective of the date of application. The same considerations would apply to supplemental type certificates, and amendments to type certificates, involving increases in passenger seating capacity and § 25.2 has been amended to make it clear that the provisions of this section will apply to any such certificate issued after the effective date of this amendment irrespective of the date of application.

It was suggested that because of necessary delays incidental to production engineering and tooling, certain of the regulations not become applicable until 18 months after the effective date of the amendment. The FAA agrees that there is a basis for an 18-month delay with respect to certain of the proposals in the notice. In this connection, we have determined that manufacturers who now have airplane type certification programs underway would be unreasonably burdened if certain of these rules (i.e., those which necessarily involve considerable engineering development and extensive changes in the type design) were to be made effective on the date of amendment as a condition for obtaining a type certificate, and that delaying their effectivity for 18 months would provide a measure of relief not inconsistent with the safety objectives of this rule-making action. Section 25.2 has accordingly been revised to segregate those regulations with which an applicant need not show compliance until 18 months after the effective date of the amendment.

Section 25.721(d). Several commentators recommended clarification of proposed § 25.721(d) with respect to the overloads and to the parts of the fuel system requiring protection. It is the intent of the section to ensure that no part of the fuel system, lines and tanks, located in the fuselage is likely to be damaged by failure of the landing gear due to overload in the vertical plane parallel to the longitudinal axis of the airplane. The proposal has been changed to reflect this intent. For the reasons set forth above, the effective date of this amendment has been postponed for 18 months.

Section 25.783. The purpose of the proposed changes to § 25.783 was to require that all passenger entrance doors in the side of the fuselage qualify as Type I or Type II passenger emergency exits. Two commentators read the proposed section as introducing substantive changes in the requirements for exits which are covered elsewhere in the regulations and stated that no explanation was given for amending the entire section. We agree with these comments to the exent that the present section should be retained with the addition of a new paragraph covering door requirements as necessary to make them emergency exits.

In connection with the foregoing, the substance of proposed § 25.783(a) has been added to presently effective § 25.783 as new paragraph (g). Moreover, in response to a recommendation, the doors to which the paragraph is applicable have been defined as "entry" doors. With reference to the integral stair, objections were made to the prohibition of any interference with emergency egress after failure of the landing gear. We agree that the emphasis should be placed on ensuring egress. Interference to a degree that will not reduce the effectiveness of emergency egress should not prevent approval of the integral stair, and the paragraph has been so revised. Finally, the proposal has been revised to state that the entry door may also qualify as a Type A emergency exit. The introduction of the Type A exit in this amendment is discussed below in connection with § 25.807.

Section 25.785(c). Various comments on the proposed requirements applicable to sideward facing seats in § 25.785(c) indicated general belief that they were overly strict inasmuch as provision for only one method of compliance was made. The FAA agrees with the comments and has provided an alternative in the form of a safety belt and shoulder harness combination. The FAA also finds merit in a further suggestion that suitable protection may be afforded by energy-absorbing material such as honeycomb, even though it is noncushioned. Section 25.785(c) has been amended to allow the use of such material.

Section 25.803. The purpose of the proposed regulation is to provide for the emergency evacuation of every occupant of an airplane, whether crewmember or passenger. To clarify this aspect of the requirement proposed in § 25.803(c) and to make it consistent with the intent as expressed in the preamble to Notice 66-26 and with § 121.291, § 25.803(c) is amended to require demonstration of evacuation of the maximum number of airplane occupants, including crewmembers, within the given time limit. Since the number of crewmembers may vary, it is reasonably set for purposes of the test at the number required by the applicable operating rules.

In response to a recommendation that the rule state when the demonstration is considered completed, the first sentence of § 25.803(c) has been amended to state that the demonstration is complete when the occupants have been evacuated from the airplane to the ground. The regulation also makes it clear that evacuees using stands or ramps allowed at the wings are considered to be on the ground when they are on the stand or ramp, provided that the acceptance rate of the stand or ramp is no greater than the acceptance rate of the means available on the airplane for descent from the wing during an actual crash situation.

One commentator pointed out that although ventral and tail cone exits are proposed as passenger emergency exits in § 25.807, they are excluded in the evacuation demonstration required in proposed § 25.803(c). Ventral and tail cone exits were excluded purposely because there is insufficient service experience in the use of these exits as emergency exits. Until more data and experience are accumulated on the effectiveness of these new exit types, the FAA has determined it advisable to preclude their use in the evacuation demonstration. In addition, the FAA cannot accept a recommendation that a new evacuation demonstration be required for passenger seating increases of 15 percent or more, rather than 5 percent as stated in the notice. The 5-percent variation will permit some flexibility, whereas any greater seating increase could reasonably be expected to involve additional exits and equipment, and changes in interior arrangement and should, therefore, require a new evacuation demonstration.

While there is no intent to require a manufacturer to simulate actual crash conditions as a part of his demonstration, nevertheless, a crash condition will be assumed to occur during takeoff. Section 25.803(c)(3) has, therefore, been changed to require that internal doors and curtains be in the configuration simulating normal takeoff. Also, § 25.803(c)(7) has been further amended to make it clear that it is the passengers rather than the crewmembers who may not have the benefit of prior practice or rehersal in fulfilling the evacuation demonstration requirements.

In addition, some question has been raised as to whether the term "previously approved" referred to approval based on the actual demonstration. Since the proposal was concerned with the need for repeating the demonstration, it should be made clear that by "previously approved" the FAA meant by actual demonstration.

The FAA does not agree with the suggestions that emergency evacuation demonstrations be the sole responsibility of the air carriers or that the manufacturer be required to demonstrate evacuation under the same conditions now imposed on the operators under Part 121. The FAA believes that since the evacuation capability of an airplane, as defined in this regulation, depends to a large degree on the design of that airplane, it is fundamental to the type certification process to ensure that the airplane has the necessary evacuation capability for the maximum passenger capacity for which certification is sought. Furthermore, for the reasons set forth in the preamble to Notice 66-26, since a manufacturer will be demonstrating the basic capability of a new airplane type, it is not necessary that the demonstration be conducted under the detailed conditions regarding crewmember training, operating procedures and similar items that are of concern to an operator. Nor do we find any justification for a recommendation that evacuation times should vary depending on airplane ground attitude since there is no apparent correlation between the degree of evacuation urgency and airplane ground attitude. Likewise, as to the same commentator's recommendation that the manufacturer be permitted to use 50 percent of the exits rather than those on one side of the fuselage, the FAA believes that the language proposed is more appropriate for type certification since it would ensure evaluation of all the required type exits and emergency evacuation installations incorporated in the type design.

Various commentators objected to the proposed 90-second evacuation time. Some indicated it was too long, others that it was not long enough, while still others took exception to any evacuation time requirement. In this matter, the basis for proposing a 90-second limit was covered in the preamble to Notice 66-26, and nothing has been presented in the comments that is persuasive of change. Numerous demonstrations by manufacturers and air carriers have indicated that the 90-second criterion is reasonable at the present, and 90-seconds as proposed is being retained. As evacuation system component and equipment advances permit reductions in evacuation time, the FAA will consider appropriate changes in the requirements.

The requirement for the designation of an escape route by a slip resistant surface as proposed in § 25.812 does not specify an emergency lighting requirement. Therefore, it is considered appropriate to transfer that requirement to § 25.803. In response to comments, the white color proposed for the slip resistant surface has been deleted since other colors can serve the purpose. Further, the rule has been amended to exclude flaps used as slides from the slip resistant surface requirement.

A recommendation that cabin inerting system requirements be added to § 25.803 in order to allow an increase in the evacuation time has not been adopted. Although such a system may have merit, studies, tests and evaluations will be necessary before such standards could be proposed.

Section 25.807. Although there was some concurrence, a majority of the comments received opposed the increase in Type I passenger emergency exit minimum height from 48 to 60 inches as proposed in § 25.807(a)(1). It was the position of those not favoring the change that evacuation effectiveness is not improved with the increased height. In this connection, recent FAA test data likewise indicates that the 60-inch door permits no material improvement in evacuation flow rates. Therefore, since the higher door has not been shown to improve the flow rate of the Type I exit and would cause an increased installation burden on the manufacturers, we believe it advisable to retain the 48-inch minimum Type I exit height currently specified in the regulations.

Section 25.807(a)(5) has been amended, in response to a recommendation for clarification of ventral exit definition, by stating that the "same rate of egress as a Type I exit" refers to a Type I exit with the airplane in the normal ground altitude with the landing gear extended. Likewise, following another recommendation, the definition of tail cone in § 25.807(a)(6) has been broadened to permit "openable" designs rather than "detachable" as proposed.

A number of commentators objected to the emergency exist distribution requirements proposed in § 25.807(c). The FAA agrees that the notice stated an unnecessarily inflexible requirement for multiple floor level exit locations at each end of the cabin and this has been relaxed to allow locations near each end of the cabin. Moreover, when a design incorporates more than one floor level exit on each side of the fuselage, there is some ambiguity as between proposed paragraph (c) and paragraphs (a) (1) and (2) of current § 25.807. We have, therefore, deleted the location requirement for the first Type I or Type II exit as stated in current § 25.807(a) (1) and (2) and substituted a similar requirement for the first floor level exit in § 25.807(c). Finally, as pointed out in the comments, the proposal did not provide for variations made necessary by cargo/passenger configurations and an exception to take care of such situations has been written into the regulation.

For the period of time since Notice 66-26 was published (over 1 year), the design-development of several large transport airplanes had indicated the desirability if not the necessity of incorporating doors whose width permits two-abreast evacuation. Under current regulations, a Type I exit need be only 24 inches wide. However, limited tests to date on an exit, designated the "Type A" emergency exit, measuring 42 by 76 inches, tend to establish that, subject to certain conditions, its evacuation rate materially exceeds the combined rate of two standard Type I exits. In connection with the foregoing, there is an industry recommendation that the rule being promulgated make provision for the "Type A" emergency exit under § 25.807(a).

In the light of recent developments relating to large airplanes, the FAA agrees that passenger emergency exit requirements should contain a standard for an exit larger than Type I. Accordingly, § 25.807 is amended to include a new standard for a "Type A" emergency exit. Although the tests previously mentioned were conducted with exits measuring 42 inches wide by 76 inches high, the FAA believes that a reduction in height from 76 to 72 inches would not have a significant effect on emergency evacuation rate. Any proposal to reduce further the exit opening size, however, would necessitate additional test data.

Section 25.807(c)(1) of the notice proposed the number and type of passenger emergency exits for passenger seating capacities up to 339. Industry response was to the effect that the combination of exit types was arbitrary and inconsistent with evacuation capabilities of the larger aircraft; that inadequate credit was allowed for Types II and IV exits, thereby tending to minimize the number of exits; and that the nonlinear assignment of exit credit versus the number of passengers was without sufficient justification. A major objection voiced was that for the new emergency exits being developed in connection with new transports, no credit was available for exits larger than Type I. One commentator recommended that the proposed table of passenger seating capacity versus required number and types of exits be deleted and that the table showing increases in passenger capacity for each type exit be amended to allow credit for Types A, III, and IV and increases for Types I and II from that proposed in the notice. Another commentator recommended retention of the present table of § 25.803(c)(1) as adequate for present size aircraft and pointed out that the proposed table did not reflect proper credit for new double size exits being designed for new large aircraft.

The FAA does not agree that the table in current § 25.807(c)(1) should be deleted in its entirety inasmuch as the current version represents many years experience with passenger configurations up to the 179-passenger limit. However, it has subsequently been determined that there is not sufficient justification for extending the table to 339 passengers. Accordingly, the current table in § 25.807(c)(1) is being retained for seating capacities up through 179 passengers. In addition, the provision set forth in current § 25.807(c)(4) is being retained to permit the passenger emergency exit relationship to be increased by not more than 10 passengers for slides, but has been restricted to airplanes having a passenger seating capacity of 189 or less.

In order to meet the industry request for more flexible and realistic standards for the individual exit types, we have amended the table in § 25.807(c)(4) to credit evacuation capability of 100 passengers for each pair of Type A exits, to increase to 45 and 40 passengers, respectively, the credit for Types I and II exits, and to give a credit of 35 passengers for Type III exits. Furthermore, in keeping with the intent of the notice that airplanes having passenger seating capacities more than 299 use only the two largest size exits, we have included the requirement that emergency exits be either Type A or Type I on airplanes having passenger capacities in excess of 299. The proposal would have permitted the use of Type I and Type II combination exit arrangement for passenger capacities between 300 and 339. This was based on the fact that the Type II exit required in the notice had to be both floor level and overwing. Since the final rule retains the current requirements for Type II, which are less severe in these respects, the passenger credit for Type II exits above a passenger capacity of 299 has been deleted.

The 100-passenger increase in seating capacity allowed per pair of Type A exits is based on tests conducted to date using both overwing and non-over-wing exits. The value of 100 is conservatively set at 85 percent of the test evacuation capacity of the non-over-wing type and is considered acceptable for all Type A exits inasmuch as the rate of evacuation of the overwing type exit, established by tests, exceeds that of the non-over-wing exit. In connection with the overwing exit, however, the tests were conducted using self-supporting and automatically deployed devices to assist evacuees in reaching the wing surface. Therefore, to ensure that overwing exits having step-down distances are as effective as non-over-wing exits, standards have been added relating to assist devices at such overwing exits.

The significant factor in achieving the Type A egress rate, is an adequate flow of passengers to the exit. Certain design features, other than the mere size of the exit, must, therefore, be incorporated in order to realize the effectiveness of the exit. In concept, the Type A exit is a system rather than a mere opening. Configuration requirements are therefore set forth, as part of the Type A exit system, concerning, among other things number, location and size of aisles, and passageways, and exterior slides.

Questions on proposed § 25.807(c)(3) (now § 25.807(c)(6)) indicated that it was unclear as to what was meant by the phrase "usable following the collapse of one or more legs of the landing gear". The intent of the requirement was to cover the situation of reduced exit effectiveness due to some restriction that would affect egress after the gear failure. The key condition for which usability is required is the critical fuselage attitude after gear failure. The paragraph has been amended, therefore, to make it clear that usability must relate to the airplane in the most adverse exit opening condition following collapse of one or more legs of the landing gear. Our further evaluation indicates that in going from gear normal attitude to critical gear failure attitude, it would be reasonable to specify, as the criterion of usability, that the tail cone or ventral exit must have a rate of egress at least equivalant to that of a Type III exit.

The passenger credit in proposed § 25.807(c)(3)(ii) (now § 25.807(c)(6)(ii)) was predicated on a tail cone exit incorporating, among other things, a Type I size opening 60 inches in height. As discussed previously, however, the Type I height is being retained at 48 inches. Since it is necessary to maintain a walkthrough from the pressure shell to the emergency exit, the 60-inch height must be retained. Section 25.807(c)(6)(ii), therefore, contains the actual dimensions of the required opening in the pressure shell rather than specifying a Type I size opening. A similar situation exists in connection with the proposed requirements for a tail cone exit incorporating a Type III size opening. Again, the intent is that an evacuee be forced to bend over the least to get through the opening so that there is minimum impedance to flow. Accordingly, to preclude floor level Type III size openings and to assure a minimum height, § 25.807(c)(6)(iii) requires that the top of the opening be not less than 56 inches from the passenger compartment floor.

Pointing out that for a tail cone exit incorporating a Type I opening, the rate of egress is at least equivalent to a side mounted Type I exit and that a passenger's ability to mount the slide is enhanced because he doesn't have to clear the exit at the same time, one commentator expressed the belief that the 20-passenger credit in proposed § 25.807(c) (3) was unduly restrictive and unrealistic. Inasmuch as recent tests have substantiated higher egress rates and studies have indicated the reduced vulnerability of the tail cone to obstructions resulting from crash damage or hazards due to wing tank fuel fires, the FAA agrees that the 20-passenger credit is conservative. We believe that the reduced vulnerability of the tail cone exit offsets the fact that there is no requirement for a "back-up" exit and that the passenger credit factor may be approximately the same as for the Type I side mounted exit. Based on the foregoing considerations, the FAA believes it appropriate to increase the passenger credit of proposed § 25.807(c)(3)(ii) (now § 25.807(c)(6)(ii)) from 20 to 25. Likewise, in connection with ventral exits, a credit for 10 passengers appears conservative. Since the FAA has previously allowed credit for 12 passengers by way of exemption, proposed § 25.807(c)(3)(i) (now § 25.807(c)(6)(i)) is relaxed to allow that higher number.

The FAA agrees with comments as to the impracticability of attempting to regulate, in general, those situations in which the location of the wing does not allow the installation of overwing exits. Each case must be governed by its own special considerations. It would appear that proposed § 25.807(c)(5) could be unnecessarily burdensome if not impossible of accomplishment where the smaller transports are involved. Therefore, the current requirement of § 25.807(c)(5) has been retained and designated as § 25.807(c)(7).

The proposed requirement in § 25.807(c)(4) (now § 25.807(c)(8)) concerning emergency exits in excess of the minimum number of required emergency exits, has been retained. The comments did not present sufficient supporting data to justify deleting this requirement.

As proposed, § 25.807(d)(1)(ii) retained the ditching exit requirements of the like-numbered present regulation governing the minimum size opening for airplanes with a passenger seating capacity of 11 or more. The proposal, furthermore, deleted the § 25.807(d)(3) equivalency provision that permitted substitution of two Type IV exits for each Type III exit. Objections were stated to both the foregoing provisions in that they did not give credit for the new larger Type A exits while at the other extreme, small diameter fuselages may not accommodate openings as large as Type III. While we do not agree that there is sufficient basis to establish a specific passenger ditching credit for the new Type A exit, the FAA believes the regulation as proposed may be broadened to make provision for credit in excess of 35 passengers in a case where the large exits and other improved designs are shown to have better capabilities. However, in view of the changes being made to § 25.807(c), there is no longer any basis for prohibiting the Type IV as a ditching exit.

One commentator suggested that in a case where a high wing airplane sinks to wing level, egress through a Type III size overhead hatch is much more difficult than through a Type I or Type II size opening. In this connection, however, the FAA is not aware of any unsatisfactory service experience with the present requirements. Furthermore, it would appear that requirements for overhead Type I or Type II size hatches would impose difficult if not impossible design limitations in small airplanes. Although the FAA finds no basis for amending requirements as to the size of overhead hatches, the FAA believes that in the light of increasing fuselage sizes, the implicit requirement of accessibility should be clarified. Section 25.807(d) is, therefore, amended to require readily accessible overhead hatches.

Section 25.809. In accordance with recommendations received in response to the notice, proposed § 25.809(f) has been revised to provide for assist means that are erected by means other than by inflation. However, for lack of supporting data to justify such a change, the requirement that the assisting means must be automatically erected has not been deleted as requested by some commentators. The proposal set forth in § 25.809(h) has been changed to make it clear that an assist means must be provided if the trailing edge of the flaps is more than 6 feet above the ground or if the wing is more than 6 feet above the ground and the flaps are unsuitable as a slide. A suggestion was made that the slide specified in §25.809 should be referred to as "rigid type" slide. This suggestion has not been adopted since requiring a "rigid type" slide could be construed as requiring a device that is not collapsible.

Section 25.811. With respect to requirements of § 25.811 concerning emergency exit markings, some comments indicated that strobe lights should be installed to assist in locating exits. Other comments pointed out the disadvantages associated with the use of strobe lights and suggested a thorough check of such lights prior to any implementation for use with emergency exits. The FAA believes that a mandatory requirement for strobe lights would be premature. However, the FAA believes that perhaps strobe light designs could be devised for complying with the requirement in § 25.811(c) under conditions of dense smoke. Each such design would have to be thoroughly evaluated during the type certification of the airplane.

Comments were also received suggesting the use of signs incorporating arrows as emergency exit markings, and suggesting that exit signs at overwing exits should not be located at that portion of the window that would be removed in the case of an emergency. In this connection, it should be noted that both the current regulations and those set forth in his regulation permit the use of signs incorporating arrows. Moreover, § 25.811 as amended herein requires that exit signs be next to or above each passenger emergency exit. A suggested change to require that emergency exit instructions be painted on a transparent panel or glass panel backed by a panel illuminated to a brightness level of 3 to 4 foot-lamberts, has not been adopted. While this suggestion could be incorporated by any manufacturer, the commentator has presented no supporting data to justify such a change in the regulations and the FAA does not consider that such a requirement is necessary as a minimum standard.

Objections were received concerning the proposed change to the color contrast requirements of current § 25.811 (h). In this regard, the comments suggested that the time between the effective date of the current rule and Notice 66-26 was not sufficient to permit the necessary evaluation of the effectiveness of the current requirement. The FAA does not agree with this comment. Experience has shown that when the color reflectance is of a low value, it is possible to get a 3 to 1 ratio as currently prescribed and still not have adequate visual contrast between the colors.

Section 25.812. With respect to the requirements of proposed § 25.812, paragraph (b) has been revised in response to a comment, to make it clear that exit locating signs that are self-illuminated by other than electrical means as well as signs that are internally electrically illuminated may be used in meeting the requirements of that paragraph.

A suggestion was made that the emergency lighting requirements are unrealistic for small business jet aircraft and that aircraft certificated to carry 10 passengers or less should be exempt from certain requirements of § 25.812. The FAA does not agree with this comment. The emergency exit location and identification requirements are particularly important for the small business jets used as executive airplanes since the applicable operating rules do not require crew training in emergency evacuation procedures or a flight attendant or passenger briefing to assist in the evacuation of the passengers of such an airplane.

In response to comments objecting to the requirement for a brightness of at least 50 foot-lamberts, the FAA has decided to retain the current requirement for a brightness of 160 microlamberts. The FAA agrees that the matter of the brightness level for emergency exits requires further investigation before attempting to revise the present requirement.

In addition to the foregoing, the requirements set forth in proposed paragraphs (c) and (d) of § 25.812, have, for purposes of clarification, been incorporated into paragraph (b) of § 25.812.

Proposed paragraph (e) of § 25.812 has been redesignated as paragraph (c) and revised to read substantially the same as the present requirement in § 25.811(f), the only change being a definition of the main passenger aisle.

In response to comments, the requirement for at least 2 foot-candles illumination in proposed paragraph (f) (now paragraph (d)) has been deleted.

With respect to the proposed paragraph (g) of § 25.812 (now paragraph (e)), comments objected to the requirement for a cabin switch for the emergency lighting system as being unnecessary. In addition, it was believed that under such a proposal, inadvertent operation of the switch is possible and might be unavoidable. The FAA believes that for airplanes having flight attendants the switch in the passenger cabin serves a necessary function in the event that the flight crew forgot to arm, or inadvertently disarmed, the emergency lighting system. The possibility that the passenger cabin switch might be misused is minimized by the requirement for a means to prevent inadvertent operation of the manual controls. The proposal has been changed to require a switch in the passenger cabin where such a switch is required by the operating rules. The rule has been clarified to provide for arming or turning on rather than switching on.

In paragraph (h) of § 25.812, the FAA proposed to require that exterior emergency lighting be provided at each overwing exit to illuminate the adjacent wing surface and the escape route from that exit. In addition, under paragraph (i), the FAA proposed to require that the means used to assist the occupants of an airplane in descending to the ground from overwing and non-over-wing exits must be illuminated. Several commentators objected on the grounds that there was no indication as to the illumination level that would be required to meet these rules. Subsequent to the issuance of Notice 66-26, however, the SAE Committee A-20 conducted a series of lighting tests on the basis of which they recommended various emergency lighting intensities wherever exterior emergency lighting is required. These recommended illumination values have been generally accepted by the various segments of the industry and the FAA finds that the recommended illumination intensities provide an adequate level of illumination for the purpose of proposed paragraphs (h) and (i). For these reasons, and since the incorporation of the various levels of illumination into the regulation serves to clarify the requirement, the FAA considers it appropriate to change the proposal accordingly. In addition, the requirement that the escape route must be indicated by a white slip resistant surface has been changed to delete the color requirement and as revised, relocated in § 25.803(e). The requirement for automatic operation of the lights when the exit is opened has also been deleted. The proposed paragraphs (h) and (i) have been redesignated as paragraphs (f) and (g), respectively.

For the reasons set forth earlier in this preamble, the effective date of the requirements of paragraphs (f) and (g) of § 25.812, have been postponed for 18 months.

Numerous comments were received requesting clarification of the requirement proposed in § 25.812(i) for illumination of the means used to assist occupants in descending to the ground. In this connection, it was pointed out that the rule should permit the use of self-illuminated slides and should specify the amount of tape or ropes used as assist means that must be actually illuminated. The FAA agrees with the need for clarification and has changed the proposal to prescribe that the assist means must be externally illuminated or self-illuminated so that the deployed assist means is visible from the airplane. However, the FAA does not consider that it is necessary to require a specific light intensity on the assist means as long as it is visible from the airplane.

The requirements set forth in proposed paragraph (j) of § 25.812 (now paragraph (h)) have been revised to state a more realistic power requirement for emergency lights. In this connection, in response to various comments, the proposal has been amended to require that the energy supply provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing.

Finally, there were various objections to the proposed paragraph (m) of § 25.812 (now paragraph (k)). The comments contend that as proposed, each light would require a separate power source and would impose penalties in terms of weight, cost, and complexity that would overshadow the benefits. The comments stated that a zone concept is employed in aircraft which should assure that a portion of the cabin lighting will remain operative following fuselage breakup. Moreover, they state that for larger airplanes it may be desirable if not imperative to have one battery serve a number of lights which are located in the general area of the battery and suggest the number of lights which might be lost due to crash damage should be in the order of 25 percent.

Upon reconsideration the FAA agrees that insofar as the proposal would have required that only those lights directly damaged by the fuselage breakup could be inoperative following the breakup, it stated an unnecessarily burdensome requirement. The FAA has subsequently determined through analysis that the zone concept for emergency lighting design is acceptable. However, the FAA recognized that in the case of aircraft utilizing the zone concept, lights in addition to those damaged by the fuselage breakup would be rendered inoperative by that breakup. On this basis, the FAA has revised the proposal to allow a lighting system in which up to 25 percent of the emergency lights, in addition to those directly damaged by the fuselage breakup, could be rendered inoperative after any single vertical separation of the fuselage. However, the revised requirement now states that the system must be so designed that certain important interior lights and certain exterior lights will remain operative after fuselage breakup.

Section 25.813. The FAA does not agree with the recommendation that the width of the passageway to Type II exits should be reduced or that the rule should permit certain obstructions. The current rules prescribe a 20-inch passageway and numerous evacuation demonstrations indicate that with all factors taken into consideration the 20-inch width is the minimum that can be accepted.

Comments took exception to the proposed § 25.813(c), contending that only the outboard seat need be limited as to seatback position insofar as obstruction to exits is concerned. Other comments stressed the increased accessibility of exits in smaller transports having a single seat on both sides of one aisle, and suggested that a different standard be made applicable to these. In the light of these comments, the FAA has reconsidered § 25.813(c) and agrees that the proposal should be revised to require that the projected exit opening not be obstructed by the seatback of the seat in the outboard position. The "projected exit opening" referred to above and in the notice is the actual, rather than the minimum required opening and the paragraph has been further amended to make this clear. Moreover, the FAA agrees that less stringent requirements are appropriate for the smaller transport category airplanes and the proposal has been changed to retain the language of the current rule for airplanes having a maximum passenger seating capacity of 19 or less, to allow minor obstructions if compensatory factors are available to maintain the effectiveness of the exit.

No comments were received with respect to proposed § 25.815 and that section is adopted as proposed in the notice.

Several comments pointed out an ambiguity in proposed § 25.817 governing the number of seats abreast in airplanes having a single passenger aisle. It was the intent of the section to limit to three the number of seats in any one row on each side of the aisle. The section has been amended to make this clear.

Section 25.853. The notice proposed to require that all compartment interior materials under § 25.853, without exception, meet certain self-extinguishing criteria, involving short flame times and burn lengths after removal of the ignition source. Many comments from industry have shown that materials that will meet these criteria are not commercially available at present in quantities suitable for aircraft production or with characteristics compatible with the production of aircraft. These comments have shown that the best available materials for interior wall panels, interior ceiling panels, structural flooring, baggage racks, partitions, draperies, thermal insulation, and coated fabric insulation covering can be made self-extinguishing within average char lengths of 8 inches when tested vertically and 4 inches when tested horizontally, under established test conditions. These comments also have shown that "flame resistance" is an adequate standard for other materials, such as floor coverings, upholstery and its covering, webbing, transparencies, window shades, thermoplastic trim, seat cushion foam, furnishing, and seals. The proposed standards have been amended accordingly in § 25.853 (a) and (b).

One commentator noted that the proposed test procedures of § 25.853 were appropriate only for cloth materials and asked for clarification with respect to glazing materials. Another commentator submitted an alternate test procedure as equivalent to the procedure proposed. In the light of these comments the FAA has reviewed the proposal and agrees that the test criteria should extend to other materials. Furthermore, with some modification, the recommended test procedure is suitable for all materials. Accordingly, Part 25 has been amended by adding a new Appendix F containing an acceptable test procedure for showing compliance with section 25.853. Section 25.853 has been amended to allow the use of this test procedure as an alternative to that proposed in the notice.

Several comments urged upgrading of the standards, maximum use of materials such as glass fiber products, and development of materials that minimize the production of noxious smoke and gas when burned. The FAA agrees that continual upgrading of the standards for fire protection of compartment interior is necessary to make the maximum possible use of the best interior materials as they become commercially available and to encourage the development of such materials. To this end, the standards in amended § 25.853 (a) and (b) are believed to represent the most advanced technology now available in this design area.

Section 25.855. The notice proposed to amend § 25.855(a) to require that all cargo and baggage compartment materials must meet the test criteria in proposed § 25.853(a). As discussed above, those proposed test criteria have been altered to reflect the current state of the art in interior materials design. As further stated above, "flame resistant" is the standard now commercially feasible for the materials used in certain applications as covered in § 25.853(b). Therefore, § 25.855(a) as amended requires that the materials used in the baggage and cargo compartments at least meet the requirement of either paragraph (a) or (b) of § 25.853, depending upon the application of the materials.

Section 25.993. The notice proposed to add a new § 25.993(f) providing that each fuel line within the fuselage must be designed and installed to allow a reasonable degree of deformation and stretching without failure or leakage, and must be enclosed in a shroud.

Several comments concerned the requirement for a shroud. However, this amendment omits such a requirement since a shroud is a device that protects against the effects of leakage rather than a device that prevents leakage. Leakage prevention is the object of this amendment. The need for a shroud should be determined, in each case, under the flammable fluid fire protection requirements of § 25.863.

One comment suggested that the proposal should be applied only to fuel lines within occupied and cargo compartments. Another comment suggested that the proposal should apply only to lines within the pressurized section of the fuselage. These comments are not accepted since fuel lines passing from the fuel tanks through any portion of the fuselage to the engines should be evaluated for leakage security.

This amendment specifies only "leakage" rather than "failure or leakage". Failures other than those that cause leakage, such as those that cause fuel stoppage only, are not the subject of this amendment.

Section 25.1359. The notice proposed to add a new § 25.1359(c) to require that electrical cables must be isolated from flammable fluid lines and must be shrouded in insulated, flexible conduit to allow a reasonable degree of deformation and stretching without failure.

One comment suggested further limitation of the proposal to main power leads only, stating that the shroud should be separate from the usual insulating cover, and stating that the proposal should apply only to cables in the vicinity of flammable fluid lines. Limitation to main power cables, including generator cables, expresses the intent of the notice and is adopted. Limitation to cables in the vicinity of flammable fluid lines is not necessary in addition to the isolation requirement since a cable not in the vicinity of a fuel line would meet the isolation condition.

One comment suggested that the cable shrouds should be in addition to the normal insulation cover and separate from the cable itself. This characteristic is a part of any main cable now used in aircraft, and was within the intent of the notice. However, this suggestion may result in clarification and is therefore accepted.

PART 37

The notice proposed to amend § 37.132, Safety Belts, TSO-C22e, § 37.136, Aircraft Seats, and Berths, TSO-C39, and § 37.178, Individual Flotation Devices, TSO-C72a to require compliance with test criteria in proposed § 25.853(a). All of the articles covered in these TSO's incorporate materials now covered by § 25.853(b). Since the standard and test procedure now applicable to materials covered by § 25.853(b) are the same as that currently applicable to the materials used in the manufacture of the articles under the referenced TSO's, it is not necessary to cross reference § 25.853 in the TSO's and the proposal is withdrawn.

Section 37.175. The notice proposed to amend § 37.175, Emergency Evacuation Slides, TSO-C69, to require that new models of such equipment must be able to be fully inflated in not more than 10 seconds after activation of the inflation means. One comment suggested that full inflation within the prescribed time limit is not essential if the slide can serve its evacuation function when less than fully inflated and suggested that the regulation should not require full inflation. While the FAA is aware that a slide may be capable of receiving an evacuee prior to the 10 seconds time limit specified in the proposal, the requirement for full inflation in 10 seconds is a design requirement considered by the FAA as necessary to ensure that the slide will provide its maximum support capability within an established period. Moreover, this regulation would not prohibit the use of a slide prior to the time it became fully inflated. The proposal has not, therefore, been changed as suggested.

In accordance with the proposal, the Applicability provision in § 37.175 has been amended to state that new models of slides manufactured after the effective date of this amendment must be designed so as to be fully inflated in not more than 10 seconds after activation of the inflation means.

Part 121

General. As discussed in the beginning of this preamble, substantive changes have been made in some amendments which, for the most part, have a postponed applicability date. As previously indicated, interested persons may submit comments on these changes.

Due to the length of time that will be necessary for the extensive retrofitting required by these amendments and the time that has passed since publication of the notice, most of the applicable dates of the new equipment provisions have been extended to October 1, 1969.

Certain existing provisions in Part 121 have been deleted since they are no longer applicable. These are §§ 121.309 (f), (g), and (h) and § 121.319. In addition, the provisions of § 121.310(h) have been transferred to § 121.309(f). Appendix D to Part 121 has been reorganized and clarified in line with existing FAA interpretations. The applicability dates in the various paragraphs of § 121.310 have been deleted and, where appropriate under these amendments, new dates have been added.

Section 121.291. *Demonstration of emergency evacuation procedures:* The comments generally agreed with the proposed reduction of time to 90 seconds that will be possible with the new equipment required by these amendments. As provided in the notice, this section will not require redemonstration, except under the stated conditions, by operators who have already met the 2-minute minimum. Due to some confusion over the meaning of the term "previously approved" in § 121.291(a)(2), this section has been changed to make it clear that the 5-percent increase is determined from the passenger seating capacity for which a successful demonstration has been conducted.

The preamble to the notice stated that demonstrations to meet the 90-seconds maximum would not be required except in one of the three situations set forth in this section. However, the notice did propose to require a demonstration meeting the 90-second maximum in those three situations even though the new equipment upon which the reduction was predicated was not required to be installed for 2 years. The FAA has determined that this demonstration requirement could prove to be an undue burden on a certificate holder initially introducing an airplane type certificated under rules that did not prescribe this new equipment. Consequently, until the new equipment is required, the 2-minute maximum is retained for airplanes that are being initially introduced without such equipment.

Section 121.310(a). *Means for emergency evacuation.* The comments on this section suggested that "inflatable" slides may not be feasible on some airplanes. Therefore, § 25.809(f)(1) has been changed to require that the slides be "erectable" rather than "inflatable" Since it was also indicated that it would take several years to install these slides and that the automatic deployment feature has not been developed for some types of floor level exits, the applicable date of this paragraph has been extended to October 1, 1969.

Section 121.310(d). *Interior emergency light operation.* It was not intended that the interior emergency lights be actually turned on during taxiing, takeoff, and landing, but only that they be activated to the extent that they will become lighted as soon as the airplane's normal electrical power is interrupted. The requirement has been clarified in this respect and has otherwise been modified as previously discussed under § 25.812(e).

Section 121.310(f)(3). *Emergency exit access.* As proposed in the notice, the provisions allowing minor obstructions have been deleted except (as discussed under § 25.813(c) above) with respect to certain smaller airplanes. In addition, for the reasons also discussed under § 25.813 (c) above, a provision has been added to prohibit obstruction of the projected exit opening by outboard seat backs adjacent to Type III and Type IV exits. Although this latter requirement was not specifically detailed in the notice, the FAA believes that it is in the interest of safety that it be adopted now. Since a compliance date has been established 1 year after the effective date of this amendment, interested persons may (as indicated previously in this preamble) submit comments on these provisions to the FAA.

Section 121.310(g). *Exterior exit markings.* The change in this paragraph was proposed because the present requirement for a reflectance ratio of 3:1 has not proven practical, particularly with respect to colors of very low reflectance. Two comments noted that the present regulation has been effective for only a short time and questioned the propriety of changes at this time. However, the necessity for the proposed revisions is readily apparent. A darker color with a reflectance of 5 percent required a lighter color with a reflectance of only 15 percent. This 10 percent difference does not provide adequate visual contrast. However, at a reflectance of 30 percent for the darker color, the lighter color is required to have a reflectance of 90 percent, which is more than is necessary for adequate visual contrast. For these reasons, the proposal is adopted without substantive change. Since this requirement need only be complied with by October 1, 1969, or when the markings are repainted, whichever occurs first, it does not present an unreasonable burden.

Section 121.310(h). *Exterior emergency lighting and escape routes.* This section incorporates § 25.812(f) which has been rewritten from the proposal in the notice. A discussion of the changes is contained in the portion of the preamble on this section. Since the provisions on the slip resistant escape route have been transferred to § 25.803(e), this section is also incorporated.

Section 121.310(i). *Other floor level exits.* This paragraph was presented as paragraph (k) in the notice and is adopted without substantive change.

Section 121.310(j). *Additional emergency exits.* The objective of this provision was to assure that all installed and approved emergency exits, irrespective of whether they were in excess of the required number, would be fully equipped and available for use in an emergency evacuation. However, it was pointed out in the comments that this would tend to penalize operators who provided extra exits since it could cause removal of some passenger seats. To avoid this problem while still maintaining the efficacy of these exits, it has been decided that instead of meeting the specific access requirements of § 121.310(f) (1), (2), and (3), they must be readily accessible to the passengers in addition to meeting the other provisions of this section.

Section 121.311 (c) and (d). *Sideward facing seats and placing of seat backs in the upright position.* The proposal relating to sideward facing seats is adopted with two minor changes in the Part 25 provisions that is incorporated by reference in this paragraph. The alternative of a shoulder harness is added and the term "cushioned" is changed to "energy-absorbing" to allow more flexibility in the type of protection that must be provided.

As proposed in the notice, the requirement that during taxiing, takeoff, and landing each seatback must be in the upright position was addressed to seatbacks affecting access to Type III and Type IV exits. The FAA now believes that notwithstanding the limited scope of the proposal in the notice, it is essential for the safety of passengers in a crash situation that during taxiing, takeoff, and landing, each passenger seatback in the airplane must be in the upright position. In adopting this requirement a provision specifically requiring passengers to comply with appropriate crewmember instructions has been included.

Section 121.312. *Materials for compartment interiors.* The notice proposed to add a new requirement that after June 30, 1968, all replacement materials used in passenger or crew compartments would have to meet the new requirements proposed for § 25.853. As discussed above, the proposed requirements for § 25.853 have been revised in this amendment. In addition, several comments pointed out that the replacement requirement as proposed for Part 121 could necessitate impractical and sometimes useless patching with new materials when making small repairs to existing cabin interiors. Since FAA's intent was to require the complete upgrading of existing cabin interiors, the rule as adopted (§ 121.312) requires that after October 24, 1968, upon the first major overhaul of an aircraft cabin or refurbishing of the cabin interior there must be a complete replacement of all material with materials that meet § 25.853. In addition, the FAA will survey certificate holders to determine when the requirements of § 25.853 would be met for each airplane in their fleets. If the results of this survey indicate that this phased replacement program will not accomplish the desired upgrading of cabin interiors within a reasonable period of time, the FAA will consider separate rule making action to establish a specific cutoff date for accomplishing such replacement.

Section 121.391. *Flight attendants*. After considering all of the comments submitted the FAA has decided to retain the limited deviation authority presently in § 121.391(b) rather than the one proposed in the notice. However, the additional limitation proposed in the notice prohibiting any operation with fewer flight attendants than the number used in emergency evacuation demonstrations under § 121.291 is being retained.

Section 121.571(b). *Passenger briefing cards*. Several comments were of the opinion that distributing cards to each passenger was impractical and would add very little to the oral briefing. There is also an FAA study in progress to determine better methods of informing passengers on emergency exists. In view of these facts, the requirement for distributing the briefing cards has been deleted from this amendment.

Section 121.589. *Carry-on baggage*. The provisions of this new section have been revised and clarified to permit more effective enforcement. The prohibition against carrying articles of baggage aboard that could slide out from under seats in the event of a crash has been postponed in order to allow installation of a means of securing them. One comment indicated that it would take several years to equip all existing seats in this manner. However, the FAA believes that such an installation will be relatively simple and can be accomplished in a much shorter period of time.

Appendix D. The changes proposed in the notice and other existing FAA interpretations (see for example item 20) are incorporated in paragraph (a) and, in addition, the paragraph is reorganized and reworded for greater clarity.

Interested persons have been afforded an opportunity to participate in the making of this amendment, and due consideration has been given to all matter presented.

(Secs. 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, and 1424))

In consideration of the foregoing, Parts 21, 25, 37, and 121 of the Federal Aviation Regulations are amended effective October 24, 1967,

Amendment 25-16

Cockpit Voice Recorders

Adopted: September 29, 1967 **Effective: October 6, 1967**

(Published in 32 F.R. 13913, October 6, 1967)

The purpose of these amendments to Parts 25 and 121 of the Federal Aviation Regulations is to revise § 25.1457(d)(2) to permit the installation of cockpit voice recorders which have an automatic means to stop each erasure feature from functioning within 10 minutes after the instant of crash impact, and to clarify § 121.359 with respect to the retention of recorded information by the certificate holders.

Current § 25.1457(d)(2) requires that cockpit voice recorders must be installed so that there is an automatic means to stop each erasure feature from functioning at the instant of cash impact. A number of different means have been utilized in the various voice recorder systems in an attempt to comply with this requirement. However, precise compliance has proven to be very difficult, and with the automatic means now available under the present state-of-the-art, there could be a period of time following crash impact during which the erasure feature continues to function. This has created no particular problem to date since all of the recorders presently used are of the continuous loop type which continue to record during the time the erasure feature is functioning. Moreover, the FAA is now aware that there are situations in which cockpit sounds, including crew voices, for a short interval after the instant of crash impact could be useful in the subsequent accident investigation. Since, under the operating rules, an operator may erase all but the last 30 minutes of recorded information, the FAA considers that in those cases where there could be an interval of recorder operation after crash impact, the cockpit voice recorder must be designed and installed so that this interval cannot exceed 10 minutes. Thus, a minimum of 20 minutes of recorded information before the instant of impact would necessarily be retained.

Furthermore, it is necessary that the recorder and the erasure feature cease to function simultaneously in order to assure a full 30 minutes of intelligible recording. This is obviously the intent of the present rules, and in all of the current voice recorder installations, the erasure feature is stopped by stopping the recorder. Therefore, for the purpose of clarifying the voice recorder requirements, it is considered appropriate to amend § 25.1457(d)(2) to specify that the automatic means must simultaneously stop the recorder and prevent each erasure feature from functioning.

Under § 121.359(e), the certificate holder must retain the recorded information for at least 60 days in the event of an accident or occurrence requiring immediate notification of the National Transportation Safety Board under Part 320 of its regulations. On the other hand, paragraph (a) of § 121.359 requires that the recorder must be operated continuously from the start of the use of the checklist to completion of the final checklist at the termination of the flight. Moreover, paragraph (d) permits the use of an erasure feature on the recorder so that information recorded more than 30 minutes earlier may be erased. The requirements of paragraphs (a) and (d) have created some concern in determining the appropriate course of action in the event of an inflight accident or occurrence. While paragraph (e) requires the retention of recorded data in the event of an accident or occurrence, this is not possible in the event of an inflight accident or occurrence since paragraph (a) requires that the recorder must continue to operate until completion of final checklist at termination of the flight and paragraph (d) permits the erasure of all but the last 30 minutes of recorded information. It is therefore obvious that the accident or occurrence referred to in paragraph (e) is not an inflight accident or occurrence but one that results in the termination of the flight. The requirements of paragraph (e) have, therefore, been amended to make this clear.

Since these amendments remove an unnecessary restriction and provide clarification of existing regulations, I find that notice and public procedure hereon is unnecessary and good cause exists for making these amendments effective on less than 30 days' notice.

These amendments are issued under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423).

In consideration of the foregoing, § 25.1457(d)(2) of Part 25 and § 121.359 (e) of Part 121 of the Federal Aviation Regulations (14 CFR Parts 25 and 121) are amended, effective October 6, 1967.

Amendment 25-17

Crashworthiness and Passenger Evacuation Standards; Transport Category Airplanes

Adopted: June 14, 1968 **Effective: June 20, 1968**

(Published in 33 F.R. 9065, June 20, 1968)

The purpose of these amendments to Parts 25 and 121 of the Federal Aviation Regulations is to clarify certain of the provisions contained in the recently adopted crashworthiness and passenger evacuation standards for transport category airplanes (Amdts. 25-15 and 121-30) published in the Federal Register on September 30, 1967 (32 F.R. 13255).

These amendments implement the determinations set forth by the FAA in its disposition of the petitions for rule making filed by the Aerospace Industries Association of America, Inc. (AIA) and the Air Transport Association of America (ATA) and as expressed in the various industry meetings held subsequent to the adoption of Amendments 25-15 and 121-30.

Section 25.803(c), concerning emergency evacuation demonstrations, states, in pertinent part, that evacuees using the stands or ramps allowed under that section are considered to be on the ground when they are on the stand or ramp: *Provided*, That the acceptance rate of the stand or ramp is no greater than the acceptance rate of the means available on the airplane for descent from the wing during an actual crash situation. The AIA has indicated that the term "acceptance rate" is confusing and suggests that the rule could be clarified by referring to "passage width" instead. The FAA agrees that equating the width of the passage to the stand or ramp with the passage width of the means available on the airplane for descent from the wing in an actual crash situation would accomplish the purpose of the regulation. Section 25.803(c) is amended accordingly.

Section 25.813(c) provides, in pertinent part, that for air planes having a maximum seating capacity of 20 or more, the projected opening of the exit provided must not be obstructed by a seatback in any position at the outboard seat locations. Subsequent to the adoption of this regulation, it has come to the attention of the FAA that in certain instances a space may be provided between the "outboard seat" and the exit. In this connection, the question has arisen as to whether this arrangement would make it unnecessary for the "outboard seat" to meet the seat back-obstruction provisions of § 25.813(c). The FAA has given careful consideration to this matter and is of the opinion that if the lateral distance between the "outboard seat" and the exit is not less than the width of the narrowest passenger seat installed in the airplane, this would provide the necessary access to the exit in accordance with § 25.813(c). The outboard seat in such a situation need not meet the seatback obstruction requirements of that section.

Section 25.853(a) states that materials used for specified applications in crew and passenger compartments must be self-extinguishing after flame removal, when tested in accordance with prescribed methods. Materials other than those specified in paragraph (a) are required to be at least flame resistant when tested in accordance with prescribed methods under paragraph (b). This section does not specify in detail the materials which are required to be tested under paragraph (a) and those materials required to be tested under paragraph (b). In response to a request by the industry for clarification of the regulations in this regard, § 25.853 is being amended to make it clear that thermoplastic window frames, clip-in trim strips, light reflectors, speaker cones, decompression grills, window transparencies, light cover transparencies not in panel form, and edge lighted instrument panels made from MIL–P–5425c finish sheet A or L–P–380a, Type II, Class 3 methacrylate molding plastic, need only be flame resistant when tested in accordance with the methods prescribed in paragraph (b). On the other hand, the FAA has now determined that since wire insulation, conduit, plastic material in "black boxes", rub strips, pulleys, and small nonmetallic materials located behind interior walls or above interior ceilings are blanketed or surrounded by thermal insulation which meets the self-extinguishing requirements specified in paragraph (a), such materials need not be tested under § 25.853. This does not include ducting material, which must meet the test criteria specified in paragraph (b).

Section 25.1359 requires, among other things, that main power cables (including generator cables) in the fuselage be isolated from flammable fluid lines and shrouded by means of electrically insulated flexible conduit, or equivalent, which is in addition to the normal cable insulation. In response to requests by the industry for clarification of this requirement, § 25.1359 is being amended to specify that it is concerned with main power cables in the fuselage only and that there is no need in the interest of safety to both isolate and shroud the main power cables.

Section 25.2 requires that applicants for type certificates and certain applicants for supplemental and amended type certificates must comply with specified airworthiness regulations in effect on October 24, 1967, regardless of the date of application or the regulations incorporated by reference in the type certificate. However, some of the airworthiness standards specified in § 25.2 are being amended by this rule-making action to either clarify or relax the requirement. Therefore, the effective date of these amended regulations has been incorporated into § 25.2, to make it clear that the persons covered under that section may show compliance with the specified regulations as amended by this rule-making action.

It has been brought to the attention of the FAA that there is a slight inconsistency in the language of §§ 25.803(d) and 121.291(a)(2) in that the former requires a repeat of the emergency evacuation demonstration for increases of more than 5 percent in passenger seating capacity while the latter refers to 5 percent or more for redemonstration. Section 121.291 is relaxed slightly to achieve uniformity in these requirements.

Section 121.310(a) was amended to provide for automatic slides at floor level emergency exits. The Air Transport Association has requested on behalf of its members that some form of deviation authority be provided due to the extensive structural modification required on some of these exits. The FAA agrees that the present design of certain emergency exits would dictate such modification and that full compliance would be unreasonably burdensome. Therefore, a limited deviation authority, subject to conditions which assure an adequate level of safety, is being included. This will permit evaluation of the merits of each case by FAA field personnel to assure the necessity for such deviation.

Section 121.310(g) requires a 2-inch colored band outlining all passenger emergency exits for identification to outside rescue personnel. However, § 25.811(f)(1) applies this requirement only to emergency exits in the side of the fuselage since the colored band is not effective with respect to other exits such as tail cone and ventral exits. Therefore, in order to achieve consistency and to remove an unnecessary requirement, § 121.310(g) is being amended.

Section 121.310(h) has been amended slightly to conform the language to the other equipment provisions of this section. The responsibility for compliance remains the same since § 121.303(d)(2) continues to impose the burden of meeting the equipment requirements.

Section 121.311(d) applies to a "person" thereby placing the burden of compliance on the pilot as well as the certificate holder. However, as indicated by the other provisions in the section, the responsibility in this case is the responsibility of the certificate holder. The section is amended to make this clear.

Secton 121.311(d) requires all seat backs to be placed in an upright position for taxiing, takeoff, and landing. However, in the past the FAA has approved procedures whereby cargo and stretcher patients could be carried with seat backs in other than the upright position. The addition of this paragraph was not intended to preclude this practice so long as access to the aisle and emergency exits was not blocked for any passenger. Therefore, the rule is clarified in this respect. In addition, it has been determined that this requirement does not significantly improve safety insofar as it applies to taxiing aircraft and as a consequence the word "taxiing" has been deleted.

Appendix D(a)(4) of Part 121 was amended to prevent the repeated use of participants in demonstrations. However, it was not intended to preclude the industry practice of using the same group of people for both the aborted takeoff and gear-up crash landing demonstrations in the same aircraft. The particular requirement has been amended to avoid this interpretation. In addition, an erroneous cross-reference in item (a)(16) is corrected.

These amendments are clarifying in nature and contain other relaxatory changes in the crashworthiness requirements that were granted to interested persons in the disposition of the petitions for rulemaking set forth in Regulatory Docket No. 7522. Therefore, I find that notice and public procedure hereon are unnecessary, and that good cause exists for making them effective on less than 30 days' notice.

In consideration of the foregoing, Parts 25 and 121 of the Federal Aviation Regulations (14 CFR Parts 25, 121) are amended, effective June 20, 1968.

(Secs. 313(a), 601, 603, 604, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423, 1424.)

Amendment 25–18

Fuel Jettisoning Systems

Adopted: August 23, 1968 Effective: September 29, 1968

(Published in 33 F.R. 12224, August 30, 1968)

The purpose of this amendment to § 25.1001 of Part 25 of the Federal Aviation Regulations is to revise the criteria for fuel jettisoning systems on airplanes.

This action was issued as a notice of proposed rule making (Notice 67–51) and published in the Federal Register on December 6, 1967 (32 F.R. 17487). The comments received in response to the notice are discussed hereinafter.

Several comments expressed concern about the relationship between an airplane's established landing distance and the corresponding runway length that would be required for landing at the airport of departure under the proposed regulation. The comments indicate that under certain conditions, the runway length for landing at the airport of departure might be more critical than the landing and approach climb requirements. In this connection, it was recommended that specific engineering data be examined for all anticipated cases where weight to meet the go-around climb gradients and weight to land and stop may be in conflict. One of the commentators stated that if the weight specified in the Notice is the most restrictive for all cases and can be proved by test-substantiated engineering data, then its concern is alleviated. This matter was considered at the time the notice was being formulated. A review of the type certification test data concerning relative takeoff and landing distances of four representative types of airplanes that varied in size and in the number and type of engines, indicated that for the critical range of takeoff weights, the runway required for takeoff would always provide an adequate margin for landings at the airport of departure. Moreover, it was shown that the runway length margin for landing increases with increases in the ratio of the takeoff to landing weight.

In a related comment the opinion was also expressed that under certain conditions, maximum brake energy capacity may be more limiting than the landing and approach climb requirement. It was suggested that the proposed rule should include language to the effect that the aircraft must be capable of stopping within the confines of the available runway at the airport of departure. The FAA does not consider that such a revision to the proposal is necessary. There has been no adverse service experience with airplanes certificated under Part 25 involved in overweight landings. Moreover, the accelerate-stop demonstration used in showing compliance with the takeoff performance requirements at takeoff weight also provides assurance of the ability to stop an airplane with takeoff weight within the confines of the available runway at the airport of departure.

A comment was also received recommending that the proposed rule be changed to permit compliance with the performance requirements specified in paragraph (c) of the proposal to be shown at a weight that is 95 percent of the takeoff weight as an alternative to the proposed requirement. The commentator stated that this is appropriate since at least two transport airplanes have been granted FAA exemptions based on meeting the performance requirements at 95 percent of the takeoff weight. The commentator further advised that, in some cases, the 15-minute fuel burnoff as provided in the proposal could amount to a weight reduction greater than 5 percent of the maximum takeoff weight if certain emergency procedures were established by the applicant for the 15-minute go-around. In this connection, the commentator also recommended that the regulation provide that the 15-minute takeoff, go-around and landing operation be conducted in accordance with emergency procedures (such as gear and flaps down and the use of augmented thrust) for operation in service.

Under the proposal, compliance with the climb requirements specified in paragraph (c) would have to be determined at a weight equivalent to the maximum takeoff weight less the weight of the fuel that would be consumed during a 15-minute flight in which the airplane is involved in a takeoff, go-around, and landing at the airport of departure. In the Notice, it was proposed that this flight be conducted in accordance with the procedures established by the applicant for operation in service, in other words, the procedures (and the resulting airplane configurations) used by the manufacturer in meeting the present performance requirements under Part 25 for takeoff and go-around operation (i.e., takeoff, balked landing, and missed approaches). In this connection, one of the commentators stated that the airplane configurations assumed in establishing the weight at the end of 15 minutes (from the point of view of aerodynamic drag) should be compatible with the approach and landing configuration assumed for compliance with the climb requirements. The FAA agrees that it would not be appropriate in the interest of safety to permit the use of special procedures designed to provide the maximum burn-off rate for the sole purpose of meeting this requirement. As indicated above, it is those procedures used by the applicant in meeting the performance requirements of Part 25 that must be used in conducting the takeoff, go-around, and landing. The proposal has been revised to make this clear. This does not mean, however, that the procedures established in accordance with the current performance requirements of Part 25 are not emergency procedures, and such procedures might, in fact, result in the configurations suggested by the commentator, provided the airplane meets the appropriate climb requirements for each stage of flight.

With respect to the commentators' recommendation concerning the incorporation into the regulation of an alternative means for determining the weight at which the climb performance requirements must be met, the FAA does not consider that such a change is appropriate. The proposal was intended to provide a regulation that can be uniformly applied on a rational rather than an arbitrary basis. Moreover, the recommendation does not provide an acceptable alternative since the burn-off rate for current aircraft designs is such that a weight established on the basis of fuel burn-off during a 15-minute go-around using the procedures for operation in service would generally be higher than the weight based on the arbitrary figure of 95 percent of the takeoff weight. Thus, incorporation of the commentators' recommendation would result in the general application of the 95 percent criteria. While previous FAA exemptions from the current requirement of § 25.1001 were based on the fact that the aircraft had been shown to meet the approach and landing climb requirements of Part 25 at a weight equal to 95 percent of the takeoff weight, these exemptions were all limited to aircraft in which the ratio of takeoff weight to landing weight was not more than 115 percent. The commentator did not recommend the incorporation of the 115 percent limitation and the FAA does not consider that such a limitation would be appropriate in a rule of general applicability.

Another comment inferred that the 15-minute period provided for in the proposal must be assumed to start at the maximum (structural) certificated weight. The commentator also assumed that for high altitude and temperature, it is permissible to take credit for the fact that the maximum takeoff weight may be limited by these conditions and suggested that the rule be clarified. The term "maximum takeoff weight" used in the rule refers to maximum weight as specified in § 25.25. This is the highest weight at which compliance with each applicable requirement of Part 25 is shown, including any limitations necessary to meet the performance requirements at altitude or at high temperatures. As stated in § 25.25 the term "design maximum weight" is the highest weight at which compliance is shown with the structural requirement. The commentator is, however, correct in his assumption that for the high altitude and temperature, the maximum take-off weight is the weight as limited by the applicable altitude and temperature at the airport of departure. This is clearly indicated in the proposal.

One of the comments recommended that the rule should be changed to require that the applicable approach and landing climb requirements be met at the maximum weight. This comment, however, does not take into consideration the fact that fuel will be consumed during the necessary takeoff, go-around, and landing at the airport of departure and, therefore, represents an unrealistic requirement.

Another commentator thought that turbine powered airplanes should be exempt from the fueling jettisoning requirement because they comply with more stringent performance regulations and because rationalization of en route terrain clearance and drift down regulations result in greater en route protection. The commentator also pointed out that while the airplane may be landing at maximum weight, it obviously has a reasonable climb capability because the airplane has already stisfied the takeoff climb regulations, and that fuel jettisoning systems impair safety if they malfunction.

This proposal takes into consideration the fact that there are high performance airplanes for which a fuel-jettisoning system may not be required. However, the FAA is not aware that all turbine engine powered airplanes have the required performance capability and the performance capability listed by the commentator does not establish a basis for exempting such airplanes.

There were comments questioning whether or not the proposed regulations could be applied to currently certificated airplanes. In response to these comments, it should be pointed out that while all operators may take advantage of the regulation, since the regulation would be the basis for increasing the takeoff weight of an airplane, they must apply to the FAA under Part 21 for approval of a change to the maximum takeoff weight.

Another comment suggested that the rule should specifically require that the fuel jettisoning system be constructed to meet the requirements of the regulation. In this connection, it was suggested that the rule should specifically refer to the "design and construction" of the jettisoning system. The FAA does not consider than such a change is necessary since proper construction is assured through the requirement that the fuel jettisoning system must be demonstrated by flight tests. However, upon further consideration, the FAA does believe that the proposal should be changed to avoid any implication that the FAA proposes design limits on the performance of the fuel jettisoning system. The final rule, therefore, incorporates the language of the present regulation and requires that the jettisoning system must be "able" to jettison the specified amounts of fuel rather than that it be designed so that it will jettison the specified amounts of fuel.

Finally, in the light of some of the comments received in response to Notice 67-51, it should be made clear that under the current regulations an investigation of the flight characteristics of an airplane would be required at the weight existing at the end of the specified 15-minute go-around. Section 25.21 provides that the flight requirements of Part 25 must be met at each combination of weight and center of gravity within the range of loading conditions for which certification is requested. The weight existing at the end of the 15-minute go-around operation referred to in this regulation will be within the range of loading conditions for which certification is requested. In addition, § 25.143 specifically requires that an airplane must be safely controllable and maneuverable during takeoff, climb, level flight, descent, and landing. Moreover, it must be determined that it is possible to make a smooth transition from one flight condition to another without exceptional piloting skill, alertness or strength under any probable operating condition.

A nonsubstantive change has been made in § 25.343(a) to correct the reference to paragraph (c) of § 25.1001 since former paragraph (c) is now incorporated in paragraphs (h) and (i).

In consideration of the foregoing, §§ 25.343 and 25.1001 of Part 25 of the Federal Aviation Regulations are amended effective September 29, 1968.

(Secs. 313(a), 601, 603, Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423.)

Amendment 25–19

Oil Tank Installation Requirements

Adopted: October 10, 1968 Effective: November 16, 1968

(Published in 33 F.R. 15410, October 17, 1968)

The purpose of these amendments to Part 25 of the Federal Aviation Regulations is to permit the installation of reciprocating engines having integral oil sumps in airplanes certificated in the transport category without requiring the oil sumps to be fireproof.

These amendments are based on a Notice of Proposed Rule Making (33 F.R. 3641, March 1, 1968), circulated as Notice No. 68–3, dated February 23, 1968.

The comments received in response to Notice 68–3 generally favored the proposal. However, one comment recommended that the proposal be changed to require a showing, either by demonstration or analysis, that the possibility of fire originating within or being exaggerated by the oil in the wet sump is extremely remote. According to the comment, the best indication of this would probably be the operational history of engines with integral oil sumps. In response to this comment, it should be pointed out that Notice 68–3 was issued on the basis of the satisfactory service experience with integral oil sumps on reciprocating engines used in small airplanes.

As stated in the preamble to Notice 68–3, the FAA has determined that because of the relatively small quantity of oil that can be carried in the integral sumps; the fact that the oil sump itself serves as a heat sink to assist in dissipating heat from a fire near the sump; and the fact that in reciprocating engines the direction of airflow around the engine will direct the flames away from the sump, the fireproofing of the integral oil sump is unnecessary. Since these conditions are characteristic of all reciprocating engines having integral oil sumps, there is no need to require a separate showing by each applicant for a type certificate for an aircraft equipped with such engines.

As previously indicated, the proposal was based in part on the fact that the capacities of oil sumps currently installed on reciprocating engines are relatively small. In this connection, none of the existing reciprocating engines or reciprocating engines currently being considered for certification have integral oil sumps with capacities greater than 20 quarts. Since the FAA's determinations as to the fire protection required for integral oil sumps did not involve oil sumps having a large oil capacity, it is considered appropriate to revise the proposed regulation to make it clear that this regulation applies to reciprocating engines having an integral oil sump of less than 20 quart capacity.

Finally, it is noted that § 25.1185(a) contains powerplant fire protection requirements for tanks and reservoirs containing flammable fluid which in some respects parallel the oil tank requirements of § 25.1013(a). Therefore, in order to fully implement the proposed regulation, it is also necessary to exclude the integral oil sumps covered by this amendment from the requirements of § 25.1185(a).

Interested persons have been afforded an opportunity to participate in the making of these amendments. All relevant material submitted has been fully considered.

In consideration of the foregoing, Part 25 of the Federal Aviation Regulations is amended, effective November 16, 1968.

These amendments are made under the authority of sections 313(a), 601 and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421 and 1423).

Amendment 25–20

Crashworthiness and Passenger Evacuation

Adopted: March 18, 1969 **Effective: April 23, 1969**

(Published in 34 F.R. 5543, March 22, 1969)

The purpose of these amendments of Parts 25 and 121 of the Federal Aviation Regulations is to revise the emergency evacuation requirements and related operating procedures for transport category aircraft. The amendments were proposed in Notice No. 68–28 issued on October 30, 1968 (33 F.R. 16147).

One proposal included in Notice No. 68–28 (Item No. 6 of the Notice) and dealing with a revision of § 121.310(h) was already adopted on February 11, 1969, as Amendment No. 121–45 (34 F.R. 2247).

Several comments were received in response to the various proposals contained in Notice No. 68–28.

With respect to Item No. 1 of the Notice—the proposed revision of § 25.785(c)—several comments went beyond the scope of the Notice and will not be considered at this time. One comment, however, suggested an 18-degree angle instead of a 10-degree angle as a standard for a seat requiring protection from head injury. After conducting additional tests on sideward facing seats, the FAA has concluded that an 18 degree angle would provide an adequate level of safety, and this standard will be adopted.

Regarding Item No. 2 of the Notice—the amendment of § 25.803—two comments objected to the way the Notice specified the limit dimensions for floor level exits/doors in the side of the fuselage because the wording might exclude Type A emergency exits 76 inches high as "impractical", and also exclude exits/doors having only one dimension that is beyond the listed limits. The FAA considers these comments valid and the proposed language of § 25.803(b) will be changed accordingly. One comment also recommended that the amendment of § 25.803(b) exclude exits/doors that lead into a baggage or cargo compartment when such compartment is not accessible from the passenger cabin. This recommendation will also be adopted in the final rule.

The comments received on the proposed revision of § 25.803(c), suggested that it would burden those persons who seek to provide exits/doors in excess of requirements, that the rule would necessitate additional emergency evacuation demonstrations, and that the proposed amendment is incompatible with current training practices which encourage the use of all exits. The FAA disagrees with these comments since excess exits need not be provided at all and, if provided, would only increase the evacuation capability of the aircraft; the rule requires no additional evacuation demonstrations since it applies only to configurations having the maximum seating capacity; and, finally, the rule does not deal with training requirements but is intentionally conservative to provide a margin of safety. The rule will thus be adopted as proposed.

With respect to Item No. 3 of the Notice—the proposed revision of § 121.285(c)—one comment suggested that no cargo whatever be carried in passenger compartments unless it is carried in approved pallets, bins, or special cargo containers. While this suggestion merits consideration, it is beyond the scope of the Notice and should not affect the minor change proposed in the Notice. Section 121.285(c) will, therefore, be adopted as proposed.

Regarding Item No. 4 of the Notice dealing with an amendment of § 121.291, the comments received were generally favorable and the proposal will be adopted.

Favorable comments were also received on the proposal contained in Item No. 5 of the Notice and § 121.310(d) will be amended as proposed. One comment, however, raised the point that the proposed rule does not make sense with respect to lights that are self-illuminated by other than electrical means since they are always armed and turned on. The proposed rule is not intended to apply to these lights such as radioactive or chemical lights on slides. It is intended to apply only to electric lights.

Concerning Item No. 7 of the Notice—the suggested amendment of § 121.310(i)—two comments dealt with exit size limits and are related to the comments made on § 25.803(b). The proposed amendment will consequently be revised to make it consistent with § 25.803(b). Moreover, one comment suggested that the phrase ". . . and that an equivalent level of safety is provided" be deleted from the waiver provision since an equivalent level of safety on some aircraft would be so cumbersome and impractical that it would defeat the purpose of the waiver. The FAA agrees and the suggestion will be adopted.

Regarding Item No. 8 of the Notice—the proposed revision of § 121.391(b)—one comment objected to the deletion of the field approval provision in current § 121.391(b) pointing out that numerous approvals have already been granted. The FAA believes that these approvals should be re-examined in light of the new rule and that the exemption procedure of Part 11 would give adequate relief in cases deserving exemption from the rule. However, in order to prevent an undue hardship, the proposal will be adopted with a provision allowing approvals granted under the current § 121.391(b) to remain in effect for one more year.

With regard to Item No. 9 of the Notice which deals with an amendment of § 121.589(b), the comments received were generally favorable but also requested an extension of the compliance date. The FAA agrees that an extension is justified and § 121.589(b) will be revised further to extend the general compliance date to August 24, 1969, and, in special cases, until October 24, 1969.

Additionally, the proposed change of Appendix D of Part 121—Item No. 10 of the Notice—will be adopted as proposed in the Notice.

There remains the question of the applicability of revised §§ 25.785(c), 25.803(b) and (c)(1) in relation to § 25.2 which deals with requirements that must be met by an applicant for a type certificate. Accordingly, § 25.2 will be revised to allow an applicant to meet either the current or revised § 25.785(c), and to require the applicant to meet the revised §§ 25.803(b) and 25.803(c)(1) as a condition for obtaining a type certificate after the effective date of this amendment.

In consideration of the foregoing, Parts 25 and 121 of the Federal Aviation Regulations are hereby amended, effective April 23, 1969.

These amendments are issued under the authority of sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354, 1421, 1423, 1424), and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-21

Maintenance Manual Requirements

Adopted: December 31, 1969 Effective: February 5, 1970

(Published in 35 F.R. 303, January 8, 1970)

The purpose of these amendments to Parts 23 and 25 of the Federal Aviation Regulations is to provide maintenance manuals for airplanes type certificated under Parts 23 and 25 of the Federal Aviation Regulations.

These amendments, together with proposed amendments to Parts 1, 43, and 91, which would provide a definition of the term "rebuild" and establish performance standards for such work, were proposed in Notice 69-10 issued on March 14, 1969 (34 F.R. 5440). Numerous comments were received in response to the Notice. In view of comments received concerning the proposed amendments to Parts 1, 43, and 91, the FAA has determined that these proposals require further study prior to final rule making action. However, the FAA does not believe that the adoption of the maintenance manual requirements should be delayed.

With regard to the proposed requirement that the airplane manufacturer make maintenance manuals available to the owner at the time of delivery of the airplane, most commentators gave wholehearted support to the proposal; however, several comments stated that manufacturers do make maintenance manuals available and therefore the proposed requirement is unnecessary. The FAA is aware that some manufacturers provide or make available manuals containing maintenance information, however, the FAA is not aware that all manufacturers make all the information considered essential for proper maintenance available at the time of delivery of an airplane. Furthermore, there are no standards prescribing the minimum content, distribution, and time the information must be available to the person who needs it. The majority of airplanes built today, both large and small, are more complex than those built in the past. New materials and new fabrication methods are being used and sophisticated equipment is being installed; all of which require maintenance instructions and techniques which are not common knowledge or used on older airplanes. The FAA recognizes that maintenance practices and requirements are not static and may change as information is developed during the service life of an airplane. Nevertheless, the information contained in the manual will increase the likelihood of satisfactory maintenance during the earliest stages of operation of the airplane.

Several comments expressed concern that the issuance of a type certificate for the airplane would be withheld pending the production of the maintenance manual and its approval by the FAA. However, it should be clearly understood that the rule merely requires the manual to be available to the owner at the time of delivery of an airplane and that it need contain only that information which the manufacturer considers essential for proper maintenance. It was not intended that the manufacturer had to supply each of the items listed unless he considers such information essential for proper maintenance. To remove any possible confusion in this regard, proposed §§ 23.1529 and 25.1529 have been revised to make it clear that the manufacturer must consider the listed items in determining the information essential for proper maintenance of his airplane.

A number of comments recommended that the criteria established in Air Transport Association of America Specification for Manufacturer's Technical Data, ATA Specification No. 100, be required to be used in preparing maintenance manuals. The FAA believes that the manufacturer of the airplane is in the best position to determine the maintenance requirements for his airplane, and that the form of the manual as well as the information contained therein, should be left to the discretion of the manufacturer. Thus, a manufacturer may use the format and indexing specified in ATA Specification No. 100 in preparing his maintenance manual as long as he considers those items listed in the regulation in preparing his manual.

One comment suggested that the maintenance manual requirement should be made retroactive. Such a requirement is beyond the scope of Notice 69-10 and therefore is not appropriately a part of this rulemaking action. As previously pointed out, some manufacturers' maintenance information has been voluntarily supplied in the past; however, because of the increasing complexity and sophistication of the new airplane designs, the FAA now considers it necessary to require maintenance manuals.

In consideration of the foregoing, Parts 23 and 25 of the Federal Aviation Regulations are hereby amended, effective February 5, 1970.

These amendments are issued under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-22

Additional Attitude Instrument in Large Turbojet Aircraft

Adopted: December 31, 1969 **Effective: February 5, 1970**

(Published in 35 F.R. 304, January 8, 1970)

The purpose of these amendments to Parts 25, 91, and 121 of the Federal Aviation Regulations is to require a third (additional) attitude indicating instrument, operating from a source of power independent of the normal electrical generating system, on all large turbojet powered airplanes operated pursuant to the requirements of Part 121; and to permit certification under Part 25 and operation under Parts 91 and 121 of a large airplane without a gyroscopic rate of turn instrument installed, if that airplane is equipped with an additional attitude indicating instrument system. Persons holding certificates issued under Parts 123 and 135 who operate large turbojet powered airplanes under the operating rules of Part 121 of this chapter are subject to this requirement.

These amendments were proposed in Notice 69-26, which was published in the Federal Register on June 17, 1969, (34 F.R. 9456).

Several comments received questioned the source and interpretation of the statistics used to establish a projected failure rate for attitude indicators. The FAA statistics are based on information received from field offices and cover unscheduled removals as well as failures. In our opinion the projected failure rate based on those statistics is valid. All statistics developed from FAA sources, as well as those submitted by the industry, point up the problem of unpredictable, irregular failures resulting in the loss of attitude reference. In this connection, it is worth noting that since the Notice was issued, another air carrier CV-880 airplane lost total electrical power while flying at 35,000 feet under VFR conditions. In that instance, a third attitude reference system would have provided a margin of safety not otherwise available if the flight had been conducted under instrument conditions.

All commentators expressed concern about reliable attitude reference, and many suggestions were made as alternatives to the proposal in the Notice. However, none of the proposed alternatives provide for gyroscopic attitude reference after total aircraft electrical failure, or for alternatives to any but single component failure. This amendment requires a system capable of attitude presentation which continues for a minimum of 30 minutes after total aircraft electrical generating system failure, using an independent instrument, amplifier (if needed), gyroscope, and power source. We believe the totally independent system to be preferable to any single component alternative suggested.

There was also criticism that the proposal was too restrictive, providing only for equipment presently available. No such restriction was intended and the agency believes this amendment establishes requirements which may be met in a number of ways.

In light of comments concerning the location of the indicator, the language of the proposal has been changed in the amendment to require the indicator to be installed on the instrument panel in a position acceptable to the Administrator that will make it plainly visible to and usable by both pilots occupying the pilot stations. This change makes administration of the rule more flexible and precludes an interpretation that two indicators are required.

Several comments emphasized the need for the third attitude indicator to be lighted during its operation. The FAA agrees, and believes that while a requirement for appropriate lighting is inherent in the regulations, the specific requirement for indicator illumination should be set forth. Therefore, the proposal is revised to state this requirement.

All commentators except one concurred in the proposed deletion of the gyroscopic rate-of-turn indicator when the third attitude indicator system is installed. The single comment proposing retention of the rate-of-turn indicator emphasized the instrument's reliability and use as a basic attitude reference. However, the FAA believes, and all other commentators apparently agree, that in large transport category airplanes the rate-of-turn indicator is no longer as useful as an instrument which gives both horizontal and vertical attitude information. Accordingly, Parts 25, 91, and 121 are amended, as proposed to authorize certification and operation of large aircraft without a gyroscopic rate-of-turn indicator if a third attitude indicating system is installed in accordance with § 121.305(j).

Comments also suggested that certain other instruments or systems be made redundant, that the attitude indicator conform to certain named requirements, and that the third attitude indicator system appear on the Minimum Equipment List. However, these suggested amendments are outside the scope of the Notice, and therefore, were not considered.

Some of the comments suggested that the time proposed for compliance was inadequate because of demand, technology, or programmed modifications. Upon further consideration, the FAA agrees that additional time for compliance should be provided. Accordingly, the proposed compliance date is revised by this amendment to allow 18 months for compliance. While this should allow sufficient time to achieve compliance, the agency realizes that unforeseen circumstances beyond the control of a particular Part 121 operator may arise and prevent the operator from achieving compliance by the date specified. Therefore, a provision is included whereby such an operator can obtain a limited extension from the FAA Air Carrier District Office charged with the overall inspection of its operation.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, Parts 25, 91, and 121 of the Federal Aviation Regulations are amended, effective February 5, 1970.

These amendments are issued under the authority of sections 313, 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354, 1421, 1423) and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-23

Transport Category Airplane Type Certification Standards

Adopted: April 1, 1970 **Effective: May 8, 1970**

(Published in 35 F.R. 5665, April 8, 1970)

The purpose of these amendments is to improve the airworthiness requirements applicable to the type certification of transport category airplanes.

These amendments are based on, and reflect comments from interested persons concerning the Notice of Proposed Rule Making published in the Federal Register (33 F.R. 11913) on August 22, 1968, and circulated as Notice 68-18.

Notice 68-18 contained over 100 proposed amendments to Parts 1 and 25, and approximately 300 comments were received in response to the Notice. Based upon these comments and upon further review within the FAA, a number of substantive changes have been made to the proposed rules and these changes are discussed hereinafter. In addition, a number of the proposals have been withdrawn for further study and future rulemaking action. Editorial revisions have also been made to more clearly state the intent of the requirements as expressed in the explanation. A number of comments recommended changes which went beyond the scope of Notice 68-18. These comments are appreciated and consideration will be given to them in connection with future rulemaking actions. Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented; however, in view of the number of comments received only the most pertinent ones are discussed herein. Except as modified by the following discussion, the reasons for these amendments are those contained in the Notice.

The Notice proposed to amend the control system requirements set forth in §§ 25.21, 25.671, 25.677, 25.695, and 25.701. One comment suggested that the proposed amendment to § 25.21(e) should be revised to delete the introductory clause so that compliance with the proposed requirements would be required whether or not a stability augmentation device is needed in showing compliance with the flight requirements. While this appears to have merit, it goes beyond the scope of the Notice and requires further evaluation. However, it will be considered in future rulemaking action. On the other hand, the FAA agrees that the detailed and complex design requirements proposed in § 25.21(e)(1) through (3) should be transferred to a new section in Subpart D which deals specifically with matters concerning design and construction, and these requirements have been set forth in a new § 25.672. Several comments pointed out that the pilot alerting type of warning proposed in § 25.21(e)(1) would be needed only for those failures of the stability augmentation system or any other automatic or power-operated system that could result in an unsafe condition if the pilot were not aware of this failure. The FAA agrees and the proposal as now set forth in new § 25.672 has been revised accordingly. The proposal would have required that the pilot be able to deactivate or override the stability augmentation device or any other automatic or power-operated device by means of normal movement of the flight controls without exerting excessive strength. However, as noted by commentators, the proposal does not take into consideration the new airplanes with fully power-operated redundant systems in which it is not feasible to deactivate or override the entire system. Therefore, the proposal has been changed to require the deactivation of the system, or the failed portion thereof, or the overriding of the failure by movement of the flight controls. In addition, the FAA agrees with a further comment that it should be possible to deactivate the system, or to override the system by movement of the flight controls in the normal sense, without requiring exceptional piloting skill or strength, and the proposal has been changed accordingly. In response to several comments, the FAA agrees that the proposed change to § 25.701 is not necessary in its entirety since the requirements set forth in § 25.671(c), as amended herein, are appropriate to cover the lift and drag control systems other than flaps. Therefore, the current provisions of § 25.701 are retained with the exception of the requirements of current paragraph (b) which have been deleted and a new paragraph has been added based on paragraph (b)(3) of the proposal to provide for unsymmetrical load conditions resulting from jamming of the flap surfaces on one side of the airplane.

The Notice proposed to amend the requirements of § 25.145(c) concerning longitudinal control during flap retraction. Several comments stated that the proposal to limit the application of power to "maximum continuous power" is unduly restrictive and that there is not need to reserve the additional power between maximum continuous power and takeoff power for contingencies since the proposal requires compliance at critical combination of weights and altitudes. The FAA agrees and the proposal has been changed to provide for the application of takeoff power, taking into account the critical engine operating conditions. In this connection, it should be noted that from a controllability standpoint (i.e., pitch-up) take-off power could be more critical. Other comments point out that the proposal would allow partial retraction of high-lift devices to be any amount of retraction that could be normally controlled by the pilot regardless of gate or detent position. This was not the intent of the proposal and it has been changed to make it clear that partial retraction of the high-lift devices is to the gated control position which has a design feature to prevent inadvertent operation beyond that position. In this connection the word "detent(s)" has been deleted since it could be interpreted to permit a simple notch in the control quadrant rather than a more sophisticated control (generally referred to as a gated position) having a rather complex notching or channeling provision through which the control lever must move. The word "pilot" has also been deleted so that the design motion criteria of the gated control position will be applicable to all high-lift device controls. Another comment expressed concern that the explanation in Notice 68-18 implies that the speed $1.2V_S$ would become a new lower limit speed for go-around. No such implication was intended. The intent of the rule is to assure that the minimum inflight go-around speed for turbojet powered airplanes is related to realistic landing touch-down speeds.

The proposed amendment to § 25.161(c)(2) to require the longitudinal trim requirements of that subparagraph to be met at the "'most critical" center of gravity has been changed to the "most unfavorable" center of gravity since the latter term is generally used in other flight requirements with respect to the center of gravity position. It should also be noted that while Notice 68-18 referred to § 25.161(c)(2)(ii), the requirement applies to all of subparagraph (c)(2).

One commentator objected to the proposed amendment to § 25.251(c) stating that the term "perceptible" was not discussed in the explanation in Notice 68-18 and that it is a meaningless term. The FAA does not agree. Perceptible buffeting means any buffeting which comes within the range of human senses. The FAA considers that continuous perceptible buffeting should not be permitted for cruise flight since pilots use buffeting as a warning means. The proposal has been changed, however, in view of other comments received and upon further consideration by the FAA, to limit the proposed requirement to the cruise configuration. The requirements of current paragraph (c) for normal flight conditions other than for straight flight in the cruise configuration are retained. Proposed paragraph (d) is renumbered as paragraph (e) and the phrase "except that load factors greater than the structural limitation need not be investigated" has been deleted as superfluous and to eliminate any suggestion that it is necessary to investigate aircraft characteristics up to limit load factor to determine buffet boundaries.

The Notice proposed to amend § 25.253 to cover upsets caused by activation of the longitudinal trim surfaces due to a malfunction in the trim control system or to improper use of the trim control by the pilot in turbulence. A number of comments were received on this proposal, including comments which raised issues which are beyond the scope of the Notice. Upon further consideration of the proposal and in view of the comments received, it is withdrawn for further study and future rulemaking action.

One comment stated that the proposed amendment to § 25.301(b) should be withdrawn and that the need for flight load measurements on a particular airplane design be established by special requirements during the type board meetings. In response to these comments it should be noted that the proposed amendment permits this procedure to be used to determine when flight load measurements are necessary. The amendment is adopted as proposed.

One comment suggested that the words "external loads" in proposed § 25.303 should be replaced with the words "internal loads" to be consistent with § 25.301(a). The FAA disagrees since § 25.301 as well as all of the other structural requirements are expressed in terms of external loads. The amendment is adopted as proposed.

With respect to proposed § 25.305(b), one commentator stated that to include the effects of ultimate deformations in static tests to ultimate loads is not consistent with industry practice and that this requirement should be deleted. The FAA disagrees, since it would be unrealistic to hold the structure to its limit deformation while the load is increased from limit load up to ultimate load. The commentator also stated that proposed § 25.305(b)(2) is covered by subparagraph (b)(3), and that subparagraph (b)(2) should be deleted because it involves complex analysis procedures. However, since subparagraph (b)(2) is merely one of three alternative procedures available to the applicant, it is being retained for those who may choose to employ precise in lieu of conservative procedures. Another commentator questioned whether the continuous turbulence analysis proposed under § 25.305(d) applies only to flight structure. The proposal applies not only to flight structure, but also to seat strength or to mass items which could cause injury to occupants. Several additional commentators contend that the method for evaluating dynamic response of an aircraft to continuous gusts is well known, while the continuous gust model of turbulence is not. It was also contended that the gust model is probably not reliable enough to make positive design decisions. Thus, these commentators consider it premature to make the continuous turbulence method a mandatory requirement. The FAA disagrees. The addition of a continuous turbulence analysis to the already required static discrete gust analysis is a necessary step forward in flight structure safety. Although this type of analysis is still developing, the technique has been and is presently being applied to the design of transport airplanes. As more knowledge becomes available, the analysis techniques can be refined, but in the meantime, the maximum degree of safety available within the state-of-the-art should be designed into airplanes. Accordingly, § 25.305(d) is adopted as proposed.

The Notice proposed to add a new paragraph (d) to § 25.307 to require that appropriate material correction factors be applied to test results when static or dynamic tests are used to show compliance with § 25.305(b). However, these factors do not have to be applied if the structure or part thereof has fail-safe features. One commenator noted that the term "fail-safe" has a special meaning within the context of structural fatigue and is directly related to the crack propagation and residual strength characteristics of a structure. Thus, with the use of particular materials, a single element could constitute a "fail-safe" structure. The FAA agrees with this comment and has clarified the final rule accordingly.

It was suggested that the proposed amendment to § 25.331(a)(3) does not cover manually operated control systems and does not consider that pilot effort governs the rate of control displacement. The intent of the revision to § 25.331(a)(3) is to consider in the design of the aircraft the maximum rate of control displacement which is consistent with normal pilot effort and normal control system function. The limits of pilot effort are contained in § 25.397. The proposed requirement applies to all types of control systems (from manual to fully powered) and is consistent with the present industry practice of designing to the actually available rates of control surface displacement. This has been made clear in the final rule. In addition, the FAA has withdrawn its proposed amendment to paragraph (a)(4) concerning maneuvers for out-of-trim conditions since the related proposal set forth in § 25.253 has been withdrawn.

The proposed amendment to § 25.351(a)(1) has been changed to make it clear that the control stop is the stop located at the control surface and that the maximum rudder deflection is limited by the control surface stop or by a 300-pound rudder pedal force, whichever is less, as specified in the explanation in the Notice.

The Notice proposed to transfer the same design dive speed requirements now contained in § 25.1505 (b) and (c) to § 25.335(b) in order that these requirements would be set forth in the appropriate Subpart of the regulations. However, a number of comments recommended substantive changes to the proposal. Since these changes are outside the scope of the Notice, they will be considered in connection with future rulemaking. The amendment is adopted as proposed.

The proposed amendment to § 25.427 has been revised, in response to a comment, to make it clear that it is necessary to design the specified empennage arrangements to both the lateral and vertical gust flight conditions, not in combination, but considered separately. Moreover, this also applies to the prescribed maneuver conditions.

It was proposed to amend paragraph (b) of § 25.471 by adding a new sentence to provide that lateral displacements of the c.g. from the airplane centerline resulting from passenger or cargo disposition which would not cause more than a 3 percent increase of the ground loads under symmetrical loading conditions need not be considered in determining the data required by this section. However, § 25.471(b) has been changed consistent with the explanation in the Notice to make it clear that the 3 percent increase may be allowed only in those cases where the increase is the result of variations in lateral c.g. locations resulting from random type loadings.

The Notice proposed to amend the hull and main float landing conditions specified in § 25.529(a)(1) to require only a single step limit water reaction, and to amend the related provisions of § 37.192(TSO C27). Upon further consideration of the proposal and in view of comments received, it appears that the manner of applying the load to the hull bottom was not completely defined in the proposal and could produce step load locations unreasonably forward of the step location. The proposal is therefore withdrawn for further study and future rulemaking action.

The Notice proposed to amend § 25.571 to provide an adequate margin for the fatigue evaluation of flight structures. One commentator stated it assumed that the 1.15 factor would also apply to pressurized structures and that it considered this to be too severe an overall factor and should be applied only to discrete load members. The FAA does not agree that the 1.15 factor is excessive for dynamic effects, especially as the manufacturer has the option to make a dynamic test in lieu of using the 1.15 factor. The proposal has been changed to make it clear that the 1.15 factor applies to pressurized as well as unpressurized structures. The FAA does not agree with the statement of other commentators that the 1.33 factor is too high or that proposed § 25.571(e)(2) is inconsistent with the ultimate static strength requirement in § 25.365(d). A factor of 1.33 applied to the normal operating (internal plus external) pressure (not maximum relief valve setting) is necessary to account for variation in cabin pressure and strength, and to provide a margin over the normal operating loads in the partially failed condition. The FAA never intended that fail-safe loads would be the normal operating loads as reflected by the current requirements of § 25.571(c). Furthermore, the FAA does not agree that the proposed additional residual static strength margin would have no effect on failure of the pressure shell or that proposed § 25.571(e)(2) is inconsistent with current § 25.365(d). Proposed § 25.571(e)(2) covers ultimate loads in the damaged condition while § 25.365(d) covers limit loads in the undamaged conditions and proposed § 25.571(e) has been changed to make this clear.

The Notice proposed to add a new § 25.581 to require lightning protection of the airplane structures. The suggestion of one commentator that the rule should require compliance with both subparagraphs (b)(1) and (b)(2) in all cases cannot be adopted since, for some purposes, it is necessary to electrically isolate some exposed parts to enable them to function. One commentator expressed concern as to the adequacy of the proposed protection against high induced current from a lightning strike causing arcing within the airplane which could result in loss of essential systems, and also suggested the word "catastrophic" be changed to "hazardous". On the other hand another commentator suggested that the proposal was too strict in that it did not take into account lesser protection requirements for components located in areas with low probability of strike attachment such as classification zone three in Advisory Circular 20-53. Advisory Circular 20-53 is concerned with fuel system lightning protection and the zone classifications in that Advisory Circular are not considered generally applicable to airframe components when the hazard may be due to a high current flow in a zone even though the point of stroke attachment may be in another zone. The FAA believes that the proposed rule will provide the desired protection insofar as it is possible within the present state-of-the-art. The rule is adopted as proposed, except that the title has been changed to read "Lightning Protection" since the requirement covers more than structures.

The proposal to amend § 25.607 has been changed to make it clear that it applies only to "removable" fasteners; that the "primary control system" is the "yaw, pitch, and roll control systems"; and that the control capability requirement is limited to those fasteners whose failure could result in a reduction in control capability below that required by Subpart B of Part 25. The FAA does not agree with the statement of one commentator that the proposal is redundant with the proposed amendment to § 25.671, since a reduction in control capability would be permitted under § 25.671.

The Notice proposed to amend § 25.611 to require accessibility for the inspections and maintenance necessary for continued airworthiness. Commentators recommended that the proposal be changed to make it clear that the inspections are not limited to visual means, that non-destructive inspection aids should be permitted, and that accessibility should be further defined. The intent of the proposal is to require means (primarily access) adequate to insure that it will be practical to carry out the necessary inspections. Furthermore, the inspection means or access provided should be practical for the inspection interval required for the particular item involved, and easy access for direct visual inspections of critical structures is necessary for an adequate inspection program. The use of non-destructive inspection aids such as X-ray, eddy current, and ultrasonic is considered acceptable where it is impractical to provide means for direct visual inspection if adequate procedures are developed, and it is shown that the inspection is effective. The proposal has been changed accordingly.

A suggestion was made that proposed § 25.615 should cover materials other than those listed in MIL-HDBK-5. However, it should be pointed out that this is unnecessary, since § 25.613 (a) and (b) cover the strength properties and design values for materials other than those listed in the military specifications. The amendment is adopted as proposed.

With respect to the proposed change in § 25.629, one commentator expressed concern that the proposal would omit the effects of Mach numbers greater than one when M_D is less than one. However, the proposed flutter instability margin is based on damping criteria when M_D is less than one and when 1.2 M_D is greater than one as set forth in proposed paragraphs (b)(1) (i) and (ii). The FAA considers that this criteria insures an adequate level of safety and the added burden of considering the effects of supersonic flight Mach numbers is not justified for airplanes which fly at subsonic speeds. It was also recommended that V_D/M_D in proposed paragraph (a) of § 25.629 should be changed to "V_{DF}/M_{DF}" to make it consistent with the speed definition and to require flight flutter tests up to the maximum demonstrated flight speed. The FAA agrees, since V_{DF}/M_{DF} can be less than V_D/M_D and by definition it is the highest demonstrated flight speed for the type design. This change has been incorporated into the final rule. Another comment concluded that while the proposed revision to § 25.629 is an improvement, it is more arbitrary than the current rule. The FAA does not agree that this proposal is more arbitrary than the current rule. Under the proposal, airplanes which have an M_D near Mach one are treated as a special case based on compliance with damping criteria, instead of a specified speed margin. In addition, § 25.629(a)(3) has been revised to make it clear that full scale flight flutter tests are required for a modification to the type design on the same basis as for a new type design.

One of the comments recommended that both the windshield and the wing should be included in the bird strike damage criteria of § 25.631. Moreover, it was suggested that the use of an eight-pound bird in this requirement may not be realistic and that a larger sized bird should be considered. Other comments suggested that only smaller sized birds be considered. The FAA does not agree that the wing and windshield should be included in this proposal. Service experience has not shown that the current windshield strength requirements for bird strikes in § 25.775 are inadequate or that a special investigation of wing structures for resistence to bird strikes is necessary. Moreover, the bird strike records indicate that encounters with birds weighing more than eight pounds are a rarity and that on the basis of probability, eight pounds is a reasonable value. In response to another comment, however, § 25.631 has been changed to make it clear that compliance with this requirement by providing redundant structure and protected location of control system elements or protective devices is acceptable. Moreover, the use of data on airplanes having similar structural design is permitted in showing compliance with this requirement.

One of the comments noted that the proposed change to § 25.683 does not indicate whether the 80 percent of the limit load on the control system is a dynamic load or takes into account the additional control system loads due to structural deflection or whether this includes the powered portion of a powered control system. However, other provisions in Part 25, namely, §§ 25.301 and 25.305, do require that the determination of design limit loads include consideration of dynamic affects and structural deflections. Moreover, the amendment to § 25.671 requires that adequate proof be provided to show that the control system can be operated sufficiently for continued safe flight and landing after any single failure in the control system. This will include the effects of the loads resulting from the failure. An additional comment stated that the wings and empennage should be subject to limit loads during the control system operation tests. The FAA does not agree that such a requirement is necessary because under § 25.305(a) it must be shown that the structure deflections under limit loads will not interfere with safe operation of the airplane. The amendment is adopted as proposed.

The Notice proposed to amend § 25.699(a) to require a means to indicate to the pilots the positions of the lift or drag devices on each side of the airplane or to indicate any unsymmetrical system operation to the pilots. Numerous comments were received questioning the intent of the proposal and as to when position indicators for the lift or drag devices are required. The rule as adopted requires an indicator for each lift or drag device having a separate control in the cockpit. An indication of unsymmetrical operation or other malfunction in the lift or drag device systems must be provided when such indication is necessary to enable the pilots to prevent or counteract an unsafe flight or ground condition.

It was recommended that the proposed § 25.721 be revised to cover failure modes of the landing gear in all directions and ground operating conditions as well as takeoff and landings. This rule is based on the operating history of transport category airplanes which shows that the predominant failure modes act vertically or fore and aft. Insofar as the recommendation covers other failure modes it is beyond the scope of this Notice. However, the FAA will study the matter further in connection with Notice 69-33 and the amendment is adopted as proposed.

In response to a comment, proposed § 25.723(b) now refers to "airplane lift" rather than "wing lift".

Concerning proposed § 25.729, it was asserted that there are no gyroscopic loads induced when the wheels stop rotating prior to gear retraction; consequently, the commentator suggested that the proposal include a statement that gyroscopic loads need not be considered when the design incorporates devices to stop wheel rotation prior to gear retraction. While the FAA agrees with this statement, the proposal need not be changed since it is inherent in the proposal that any particular load which becomes zero or insignificant during any portion of the retraction or extension cycle need not be considered during that portion.

It was recommended that the proposed amendment to § 25.733(a) should be changed to delete the words "critical condition" to avoid the interpretation that the tire placard speed could not be exceeded for an emergency condition such as a high weight, flaps-up landing. The FAA does not agree. A tire speed rating should not be exceeded under any conditions considered critical regardless of operational envelope. Another comment recommended that in addition to tire speed rating, the design skid depth must also be met to provide proper tire installation. The addition of a skid depth requirement in § 25.733 would require further study and is beyond the scope of this Notice. However, it will be evaluated in future rulemaking actions. After further consideration, the FAA considers that reference to the "Tire and Rim Association" in § 25.733(a) is not appropriate since it implies that no further tire qualification beyond assignment by the "Tire and Rim Association" is required. This, of course, is not the case and the proposal has been changed to refer only to approval by the Administrator. In addition, the proposal has been changed to make it clear that a "suitable tire" means a tire of "proper fit".

The Notice proposed to add a new § 25.773(c) to require a means to prevent internal windshield fogging in the pilot compartment. One comment pointed out that the use of the words "windshield fogging" in the proposal could be interpreted as requiring only forward visibility, whereas "paragraph (a)" provides for pilot compartment visibility. The FAA agrees and the proposal has been changed to make it clear that it includes windows as well as windshields and covers fogging from all internal and external ambient conditions, including precipitation conditions, in which the airplane is intended to be operated. Another commentator urged that the proposed rule should not require defogging means for inherently fog-free panes or for transparent areas not needed in the conduct of certain operations. Areas which are shown to be inherently fog-free comply with the proposed rule. Furthermore, the FAA does not consider it practical to establish boundaries of visibility for the different stages of flight and ground operations.

In response to numerous comments, the proposed amendment to § 25.863 has been substantially revised. A number of comments objected to the proposed paragraph (a) which would require fire or overheat detectors and fire extinguishing means in specified areas of the airplane. A study of the research conducted on this matter and subsequent service experience has shown that other methods of fire protection may be equally or more effective and that each area should be carefully examined with respect to the potential sources of combustible materials and ignition and appropriate fire protection means provided to prevent the occurrence of a catastrophic fire. Therefore, the proposal has been relaxed by withdrawing paragraph (a). However, proposed paragraph (b) of the Notice has been retained as the new paragraph (a); stating the basic objectives of (1) preventing the ignition of flammable fluids and (2) minimizing the hazards in the event an ignition does occur. In addition, a new paragraph has been added which lists those factors (among others) that the applicant must consider in showing compliance with these objectives. A requirement for a means to alert the crew when an action by the crew is necessary to counteract or prevent a fire has been incorporated in a new paragraph (c) in view of the withdrawal of the proposed paragraph (a).

A comment was also received stating that the proposal to require fire detectors and extinguishers be extended to include Class "D" cargo compartments. The FAA is not in a position to respond to this comment since the research program referred to in Notice 68-18 is still being evaluated. However, it should be noted that Notice 69-33 includes a proposal to require cargo compartment linings to have improved fire resistance characteristics.

In response to comments received, the proposed requirement of § 25.865 has been changed to make it clear that it is only those flight controls, engine mounts, and other flight structures which would be damaged by the "effects of fire" that need be constructed of fireproof material or shielded. In response to another comment, § 25.865 has been changed to make it clear that it is the "essential" flight controls with which the regulation is concerned.

One comment objected to the proposal to add a new § 25.901(c) to require a powerplant installation fault analysis on the basis that the requirement is covered in the proposed amendment to § 25.1309. The FAA agrees that the requirement is adequately covered in § 25.1309 and the proposal has been changed to make it clear that compliance with § 25.1309 is required.

The purpose of the proposed amendment to § 25.903(d) is to insure that, for turbine engine installations, design precautions are taken to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire originating in the engine which burns through the engine case. Comments were received objecting to the proposed words "design precautions to minimize hazards to the airplane" in that they would be subject to interpretation. However, this wording is contained in the current regulations and no change to these words or their meaning is intended. Another comment stated that containment precautions and engine integrity should be the engine manufacturer's responsibility and covered under Part 33. The FAA does not agree. Service experience has shown that additional safeguards in the installation of the engine is necessary over and above those provided by Part 33 to minimize hazards resulting from engine rotor failure or engine case burn through. The amendment is adopted as proposed.

The Notice proposed to amend § 25.951(b) to require the fuel system to be arranged so that hazardous amounts of air cannot be introduced into the system by any fuel pump. Several comments were received questioning the meaning of the word "hazardous". The FAA agrees that the word "hazardous" with respect to air in the fuel system is not sufficiently clear. In order to provide the necessary clarification, the word "hazardous" has been deleted and the rule now specifies that any air which is intorduced into the system may not result in engine flame out or power interruption for more than 20 seconds.

The Notice proposed to amend § 25.959 to require that a determination be made of the unusable fuel quantity for each fuel tank and its fuel system components at which the first evidence of engine malfunction occurs under certain conditions. One comment suggested that the proposal should be based on system malfunctioning rather than engine malfunctioning. The FAA disagrees. The important factor in determining unusable fuel is the time at which the engine malfunctions and present day aircraft have been type certificated on this basis. The amendment is adopted as proposed.

The Notice proposed to amend the fuel system hot weather test requirements of § 25.961(a)(5) to require the fuel temperature for the climb test to be accomplished at the highest temperature selected by the applicant for the operation of the airplane, but not less 110°F. Upon further consideration of the proposal in the light of comments received, the FAA has determined that the current requirement that the fuel temperature may not be less than 110°F is adequate and the proposal is withdrawn. Furthermore, the proposed amendment to clarify the requirement of § 25.961(a) concerning the critical pump inoperative condition has been withdrawn for further study and future rulemaking action.

There was an objection to proposed new § 25.994 which would require fuel system components in an engine nacelle or in the fuselage to be protected from damage which could cause the release of fuel as a result of a wheels-up landing. One commentator stated that the proposal is unreasonable for airplanes that do not have aft mounted engines and that the proper use of the fuel shutoff valves required by § 25.1189 would be a more rational method of achieving the intent of the proposal. The FAA disagrees. The criteria in § 25.1189, applicable to a fuel shutoff valve is inadequate to achieve the purpose intended by proposed § 25.994. Furthermore, the use of fuel shutoff valves in lieu of protective structural design would not provide an adequate level of safety . The amendment is adopted as proposed.

The Notice proposed to amend § 25.997(a)(1) to require a fuel strainer or filter only between the tank outlet and the engine-driven positive displacement pump inlet when an engine-driven positive displacement pump is used. One commentator stated that a requirement for a strainer to protect all types of positive displacement pumps appears to be extreme. The FAA does not agree. The proposal merely relaxes the present requirement by eliminating the requirement for a filter between the tank and the pump when the pump is other than a positive displacement type. Service experience has not shown that further relaxation is warranted and the amendment is adopted as proposed.

It was proposed to amend § 25.1091(d)(2) to require in part that airplanes be designed to prevent water or slush on the runway and any other airport operating surface from being directed into the engine air inlet ducts in hazardous quantities. One comment stated that the proposal could have a restrictive effect on the designer's freedom of choice of aircraft layout without increasing safety. Another comment suggested that the proposal be revised to give the applicant the alternative of establishing operating limitations setting forth the depth of water or slush in which the airplane could be operated and a limitation on the speed range in which it would be permissible to operate thrust reversers. The FAA considers that in this case the suggested operating procedures or limitations would not compensate for a lack of the proposed design requirements. Experience has shown that it is possible to design and prevent such ingestion and the amendment is adopted as proposed.

The Notice proposed to amend § 25.1093 to cover turbine engine ice protection. Upon further consideration of the proposal and in view of comments received, the FAA has determined that the proposal should be withdrawn for further study.

The Notice proposed to add a new § 25.1103(d) applicable to induction system ducts. The proposal would require that, for turbine engine bleed air systems, no hazard may result if a duct rupture or failure occurs at any point between the engine port and the airplane unit served by the bleed air. One comment considered the use of the words "no hazard" as unrealistic and an over-simplification of a complex situation. Commentator suggested that the proposal should be revised to specify acceptable limits on heat exposure in the various areas of the airplane where duct rupture or leakage could occur. The FAA does not consider it practicable to establish numerical limits or a specific number for temperature and pressure because of the numerous variable factors involved. Each airplane must be evaluated on an individual basis. Furthermore, the proposal has been applied as a special condition with no apparent difficulty. The amendment is adopted as proposed.

The Notice proposed to amend § 25.1143(e) to require each power or thrust control to have a means to prevent inadvertent movement of that control into any position that will reduce the fuel flow to the engine(s) below the fuel flow necessary for normal flight idle operations. The proposal would also require a positive lock or stop at the flight idle position. Several commentators objected to the use of the words "flight idle" and contended that they are improper in that they could lead persons to believe that any position below the flight idle position results in a fuel cut off. The FAA agrees. The intent of the proposal is to preclude inadvertent movement of the control into the cutoff position and to require a separate and distinct motion on the part of the crew to shut down the engine, which may be accomplished by means of shutoff levers. The proposal has been revised accordingly.

Proposed § 25.1189(a)(2) has been changed to make it clear that a shutoff means is not required for oil systems for turbine engine installations in which all external components of the oil system, including the oil tanks, are fireproof.

The Notice proposed to add a new § 25.1189(g) to require each flammable fluid shutoff valve and control to be fireproof or to be located so that exposure to fire will not affect its operation. In response to comments received and consistent with the intent of the Notice, the proposal has been changed to make it clear that it applies only to flammable fluid shutoff means and controls located in a fire zone or that would be affected by a fire in a fire zone. The proposal as revised is adopted as an amendment to current paragraph (d).

The Notice proposed to add a new § 25.1192 to require an engine accessory section diaphragm for reciprocating engines. As a result of this amendment, § 25.1181(a)(3) is amended to except reciprocating engines from the requirements of § 25.1181(a)(3).

The proposed amendment to § 25.1195(b) has been changed to make it clear that each of the two discharges of the fire extinguisher system must produce adequate agent concentrations to extinguish fires.

The amendment to § 25.1203 changes the words "fire detector" to "fire or overheat detector". It should be noted that while TSO C-11(d) is titled "fire detectors", it is equally applicable to overheat detectors.

The Notice proposed to amend the flight and navigation instruments requirements of § 25.1303. Upon further consideration, the FAA considers that proposed subparagraph (b)(1) should refer to an "airspeed indicator" rather than an "airspeed indicating system" as proposed. Since this requirement is concerned with flight and navigation instruments, the FAA agrees that the term "airspeed indicator" is more appropriate here. One comment contended that the requirement in proposed subparagraph (b)(4) for a rate-of-turn indicator should be deleted because the state-of-the-art in modern aircraft instrument systems has negated the need for a rate-of-turn indicator. The FAA agrees that the rate-of-turn indicator may be omitted if the airplane has a third attitude indicator. This change has been incorporated by a recent amendment to Part 25 (Amendment 25-22, 35 F.R. 304). It was also recommended that if the rate-of-turn is not deleted, the requirement should be transferred to proposed paragraph (a) so that it need only be visible from each pilot station but not installed at each pilot station. The FAA does not agree. Gyroscopic rate-of-turn instruments are still used occasionally as direct flight instruments in the sense that information displayed is used in a positive feedback manner by whichever pilot is manipulating the controls. For this reason, this instrument should be installed at each pilot station. The amendment is adopted as proposed except that subparagraph (b)(1) has been changed to refer to an "airspeed indicator".

A number of comments suggested that several of the required powerplant instruments set forth in the proposal to amend § 25.1305 be specified in more detail. However, the instruments are defined in objective terms in order to avoid unnecessary restrictions on design, and the amendment is adopted as proposed.

With respect to the proposed amendment to § 25.1307, it was recommended that certain items listed in the proposal should be deleted on the basis that they are covered in other sections of Part 25. The FAA does not agree with this comment. While equipment listed in § 25.1307 may be referred to in other sections of Part 25, the listing of such equipment in § 25.1307 is necessary since it is only there that the equipment is required. The other sections generally treat the equipment from the standpoint of performance, reliability, and installation. It was contended by one commentator that the duplication of communication and navigation radio equipment required by § 25.1307 imposes type certification rules more stringent than § 91.33 or § 121.345. While the FAA agrees that under Parts 91 and 121 there are situations in which an airplane can be operated without two communication and navigation systems, there are always operations in which a transport category airplane would be involved which do require dual systems. Therefore, the FAA considers it necessary to make this a design requirement for all future transport category airplanes. In response to another comment, § 25.1307 has been amended to make it clear that some interconnection or component sharing is permissible if system reliability is not impaired. In this connection, the word "independent" has been removed and the regulation now requires that there be two systems for two-way radio communication designed and installed so that failure of one system will not preclude operation of the other system. In addition, the use of a common antenna is acceptable if adequate reliability is shown.

The Notice also proposed to amend the equipment systems and installation requirements of § 25.1309. In response to a comment, the words "and installed" have been deleted from paragraph (a) of § 25.1309 to make it consistent with the remaining provisions of that section. Numerous and detailed changes have been made to paragraph (b) of § 25.1309 in response to various comments received. Several comments concerned the flush paragraph following proposed subparagraph (b)(2) which states that failure condition means a single failure or malfunction or damage from external sources, and any combination of failures, malfunctions and damage from external sources. The commentators contended that this provision would require protection against any number of improbable conditions involving any combination of system failure and damage from external sources. This was not the intent, since other provisions of the proposal would limit the failure combinations to those that would preclude safe flight and are not extremely improbable. The proposal has been clarified in this respect by deleting the paragraph in question, and adding another requirement which states that the failure analysis must include consideration of the probability of multiple failures and undetected failures. However, the FAA does not agree that the proposal should be changed to require that multiple failures of airplane systems and associated components be considered only when the first malfunction would not be detected during normal operation of the system or when the first failure would inevitably lead to other failures. Existing transports exceed such a requirement in critical systems, and service experience has shown that these additional back-up provisions are necessary for safety. With further reference to paragraph (b) the FAA has determined that the phrase "without exceptional skill or strength on the part of the crew" is redundant and that the word "minimized" should be replaced by the word "improbable". Moreover, while the term "marginal physiological condition" would generally include oxygen depletion, depressurization, and other similar conditions, it was the intent of the proposal to cover only these occurrences that could cause injury to an occupant. For this reason, the final rule has been changed to require that airplane systems and components be designed so that the occurrence of a failure condition which would result in injury to the occupants is improbable. Finally, the FAA does not agree that the requirements of proposed § 25.1309 (c) and (d) are repetitious or too detailed. The provisions of paragraphs (c) and (d) were proposed to introduce monitoring and failure warning requirements and failure analysis criteria which do not exist in the current regulations.

In response to a comment received, proposed § 25.1309(e)(4) has been clarified by replacing the words "two sources of power" with the words an "alternate source of power." This is necessary to remove the implication that "two sources of power" referred to systems which require two different forms of power such as a.c. and d.c. at different voltages.

The Notice proposed to add a new § 25.1322 to standardize the color of warning, caution, and advisory lights. In view of the comments received, and the difference between the current standardization requirements in the corresponding provisions of Parts 27 and 29 and of those proposed in Notice 67-14 for Part 23 airplanes which were withdrawn for further study (34 F.R. 13085), this proposal is also withdrawn for further evaluation with a view to future rulemaking action designed to standardize the color of such lights for all aircraft.

The introductory statement to § 25.1333 has been revised to replace the words "at the first and second pilot's station" with the words at "each pilot's station." This is appropriate since not all airplanes have two pilot stations. In addition, paragraph (b) of § 25.1333 has been substantially changed in response to numerous comments. In this connection, paragraph (b) now refers to the "equipment, systems and installations" rather than systems only to make it consistent with other parts of the regulation. The FAA also agrees that the intent of § 25.1333(b) is that if one pilot's instrument fails, the failure should not cause failure of the other pilot's instrument. Moreover, the FAA agrees that to require information to be available separately to each pilot after multiple failures would not be reasonable. The final rule has been changed to make this clear. The FAA, however, does not agree with one commentator that the system may be designed based on the criteria that one display of information essential to the safety of flight which is provided by the instruments, must be available after only a single failure. The FAA considers the single failure criteria alone to be inadequate for airplanes currently being developed and anticipated in the future. Therefore, the final rule retains the requirement that combinations of failures that are not shown to be extremely remote must be considered. In connection with § 25.1333(c), one comment noted that the proposal is more severe than the current rule. It is the intent of the FAA to prohibit the connection of additional instruments to required instruments unless the continued operation of those required instruments can be assured following failure of the additional instruments. The proposal accomplishes this objective. Finally, § 25.1333 has been changed to assure that essential information will remain available to the pilots after certain failures, without additional crewmember action.

In response to a comment, the proposed amendment to § 25.1355 has been changed by retaining current paragraph (c) of § 25.1355. However, the FAA does not agree that retention of current paragraph (b) is necessary since this material is adequately covered in the amendment to § 25.1309(e)(4).

The Notice proposed to amend the ditching equipment requirements of § 25.1415(b) to permit airplanes certificated for the carriage of cargo only to either be equipped with enough rafts of sufficient bouyancy to accommodate the minimum flight crew, or to meet the current rule which requires all transport category airplanes to be equipped with rafts of sufficient bouyancy to accommodate all occupants of the airplane in event of loss of one raft of the largest rated capacity. One comment objected to the proposal on the grounds that it is not consistent with the fail-safe principle of transport category airplane design and discriminates against the flight crews of cargo only airplanes. The FAA agrees and the proposal has been withdrawn.

In a comment concerning the ice protection requirements of proposed § 25.1419, it was asserted that demonstration of the effectiveness of the airplane ice protection system by flight tests in natural icing conditions would deter the development of icing tanker airplanes for system testing and also will delay the large-scale use of anti-icing systems on general aviation airplanes. However, notwithstanding this comment, the proposed rule does provide for the use of icing tankers; thus, recognizing their usefulness and encouraging their development. Experience has shown that there is no means at hand to evaluate the complete airplane anti-icing system other than by exposing it to natural icing conditions. However, the proposed rule does not require the total anti-icing compliance to be substantiated solely by natural icing flight tests, and icing tankers are a primary means of obtaining data to enable the analytical substantiation. The amendment is adopted as proposed.

One comment indicated that the proposed change to § 25.1435(a)(4) could dictate design unrealistically for it does not allow for expected pressure transients that have been accounted for in the design of systems. The intent of the proposal is to limit transient pressures to relatively low specific values because service experience has shown that the current general requirements are too broad to ensure the necessary reliability in modern complex hydraulic systems. The change recommended by the foregoing comment would provide a level of safety below the current rule because it would permit transients of any magnitude and frequency based on structural analysis alone, without regard to system performance capability. Another comment indicated that § 25.1435 was inadequate in that it did not cover "pump ripple pressure". The FAA disagrees. The ± 10% tolerance in the proposal is intended to take into account "pump ripple pressure" amplitude either at the outlet of the pump or at the pump transient pressure dampening device, if provided. A final comment regarding § 25.1435 stated that there is no reason to place arbitrary limits on transient pressures and stated that the manufacturer should be entitled to provide the necessary static and fatigue strength. The FAA does not agree. The reason for the limits, as confirmed by service experience, is that a dynamic system, such as a hydraulic power application system, is adversely affected by pulse loads which may fall within the static and fatigue "strength of materials" criteria of the components. This comment overlooks the synergism which is characteristic of any complex dynamic powered control system. The amendment is adopted as proposed.

Although the proposals to establish turbulence criteria for turbine-engine-powered airplanes in new § 25.255 and to define turbine penetration speed in § 1.1 have been withdrawn for further study, the FAA considers it appropriate, pending the adoption of such criteria, that the Airplane Flight Manual contain the applicant's recommended information regarding operating procedures in turbulence. New § 25.1585(a)(8) has been revised accordingly.

The Notice proposed a clarifying amendment to the definition of "accelerate-stop distance" in § 1.1. However, in view of comments received, it appears that the definition should not be changed until consideration is given to the effect that changing the meaning of the term might have on the requirements of the other Federal Aviation Regulations in which this term is used. The proposal is therefore withdrawn for further study and future rulemaking action.

In consideration of the foregoing, Parts 1 and 25 of the Federal Aviation Regulations are amended effective May 8, 1970.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423), and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25–24

Requirements for Attitude Instrument Replacement of Rate-of-Turn Indicator

Adopted: April 29, 1970 **Effective: May 9, 1970**

(Published in 35 F.R. 7108, May 6, 1970)

The purpose of these amendments to Parts 25, 91, and 121 of the Federal Aviation Regulations is to require that the third attitude indicating instrument system be

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capable of providing reliable reference through 360° of pitch and 360° of roll when that instrument replaces the gyroscopic rate-of-turn indicator, as authorized by Amendments 25-22, 91-71, and 121-57 [35 F.R. 304].

In adopting those amendments, the FAA reached the conclusion, and all commentators apparently agreed, that in large transport category airplanes the rate-of-turn indicator is no longer as useful as an instrument which gives both horizontal and vertical information. However, for such a conclusion to be valid, in those cases in which the third attitude indicating system is to be used as a replacement for a gyroscopic rate-of-turn instrument, it must be capable of reliable reference through 360° of pitch and roll so it can be used for recovery from extreme attitudes. While such a requirement is deemed essential for reasons of safety, it is not expressly stated in the rule prescribed in Amendments 25-22, 91-71, and 121-57. This clarifying amendment makes such a requirement explicit.

In addition to the use of full range gyroscopic attitude instruments, it is the intent of this amendment to permit the use of an instrument which uses controlled precession of short duration at about 90° of pitch to achieve the required range, if the instrument provides a horizon display before and after the precession which is sufficiently accurate to enable recovery to be made to approximately level flight.

Since these amendments are clarifying in nature, I find that public procedure is unnecessary and good cause exists for making them effective on less than 30 days' notice.

In consideration of the foregoing, Parts 25, 91, and 121 of the Federal Aviation Regulations are amended, effective May 9, 1970.

These amendments are issued under the authority of sections 313, 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354, 1421, and 1423), and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25–25

Additional Flight Recorder Data and Other Requirements

Adopted: August 12, 1970 **Effective: September 18, 1970**

(Published in 35 F.R. 13191, August 19, 1970)

The purpose of these amendments to Parts 25 and 121 of the Federal Aviation Regulations is to: (1) increase the recorded flight data required by Part 121 for large airplanes, for which a type certificate is issued after September 30, 1969, that are turbine engine powered or certificated for operation above 25,000 feet altitude; (2) change the requirement for keeping the recorded data; (3) require a means to automatically prevent data erasure after crash impact on flight recorders which erase and re-use tape; (4) require a device to assist in the location of flight recorders under water; and (5) require a means to correlate the time of recorded data with the time of radio communications between the airplane and air traffic control.

These amendments are based on Advance Notice 67-6 (32 F.R. 3226) and Notice 69-3, which was issued on January 14, 1969, and published in the Federal Register (32 F.R. 941) on January 22, 1969.

The Air Lines Pilots Association (ALPA) submitted a comment in qualified support of the proposal. The ALPA supports flight recorders for the single purpose of providing information in accident investigations to prevent similar accidents. The ALPA states it has become increasingly concerned with the misuse of information recorded aboard aircraft solely for accident investigation purposes, and further states that its support is given with the understanding that flight recorder information will be used for accident investigation purposes only and that the proposed rule will be amended to expressly prohibit the use of the information to discipline flight crewmembers.

The ALPA expresses the view that the amendment it recommends is consistent with its petition filed with the FAA on May 24, 1968, which recommends that the Federal Aviation Regulations be amended to preclude the use of information derived from cockpit voice recorders to discipline flight crewmembers. The FAA will consider the ALPA's recommendations concerning the use of the flight recorder information in connection with the ALPA's petition of May 24, 1968, concerning the use of cockpit voice recorder information.

The National Transportation Safety Board's comments support the proposal and recommend its application to new and existing type airplanes. The Board submitted information on specific cases to show how the proposed additional data might have increased the speed and accuracy of past accident investigations. The Board asserts that the additional data will enable the investigator, for the first time, to define the external or environmental forces exerted on the aircraft and the pilot's control forces exerted on the aircraft, and will display the aircraft's response to these forces. The Board further asserts that the utilization of the additional data is a great step forward and will give the Board the capability to study and analyze the "complex interactions between the man-machine environment, the capability for which, heretofore, has not been possible.

The Air Transport Association (ATA) opposed the retrofitting of existing type certificated airplanes and submitted comments concerning the need for additional data and the cost and other disadvantages of retrofitting airplanes in service. The ATA contends the usefulness of the additional data on existing airplanes is diminished by the fact that the mechanical and operational characteristics are well known for existing airplanes and that the useful life of existing fleets will be short after retrofit, which will take several years. The ATA's comments emphasize that the installation and maintenance costs are substantial and that there is a shortage of manpower skilled in the installation and maintenance of electronic equipment.

The ATA contends that the cost of retrofitting existing fleets is not justified by the benefit, considering that the useful life of existing fleets will be largely terminated by 1980, particularly in view of the cost of other new electronics safety equipment that is planned for these airplanes during the 1970's, such as altitude alerting, collision avoidance, area navigation, and automatic landing equipment. The ATA points out that retrofitting, which requires the installation of numerous transducers in the existing airplane systems and extensive wiring in addition to multiplexer-digitizer equipment and recorders, would be an extremely difficult task. The ATA's comments cite serious development and reliability problems experienced by one air carrier in retrofitting and operating 16 airplanes with a recording system.

Under the Notice, the requirement for recording the additional data would have applied to large airplanes that are certificated for operations above 25,000 feet altitude or are turbine engine powered regardless of type certification date. After consideration of all the information presented concerning the applicability of the proposal, the FAA has decided to limit the applicability of the proposed and require the recording of the additional data only on large airplanes for which a type certificate is issued after September 30, 1969, that are turbine engine powered or certificated for operation above 25,000 feet altitude.

The Notice proposed changes in the data retention requirement in § 121.343 to permit the use of magnetic tape and data erasure and tape re-use techniques. Flight recorders presently in use retain more than 200 hours of information on foil tape that is not reused. These tapes are saved for 60 days, under present § 121.343(c), after removal from the airplane. Therefore, existing recorders can provide data for the duration of any flight that terminates in an accident and many hours of data on flights preceeding an accident. In view of the need for recorded data for a sufficient period before an accident to reconstruct the flight and the need to limit the size of magnetic tape containers to permit adequate crash protection, the FAA proposed to require that the certificate holder retain at least 25 hours of recorded data for presently required information, and such a requirement is adopted herein.

With regard to the additional information, the FAA proposed to require that only one hour of data be retained. The shorter retention period for the additional data was proposed to allow the use of spare recording tracks on existing cockpit voice recorders to record the additional data. This method of recording the data would cost less than the cost of replacing the flight recorders on existing fleets of airplanes with entirely new flight recorder systems. Such use of voice recorders instead of new flight recorders, to record the additional data on existing airplanes was considered appropriate in view of the cost of retrofitting the large number of airplanes subject to the proposal.

Since the requirement for recording the additional data under the rule as adopted herein applies only to airplanes issued a type certificate after September 30, 1969, and such airplanes are expected to be equipped with flight rcorders that retain all of the required data for at least 25 hours, it appears that the need for the shorter retention period for the additional data no longer exists. However, in view of the 1-hour retention period proposed in the Notice for the additional data, the rule as adopted herein also contains a 1-hour retention requirement.

Notwithstanding the adoption of the 1-hour retention requirement in conformance with the Notice, the FAA is considering further rule-making action to require retention of all the recorded data for 25 hours. A 25-hour retention requirement is compatible with present flight recorder technology and will fulfill the need for as much operating history as possible to reconstruct flights subject to accident investigations. In addition, a 25-hour retention period will provide more useful information on the operating characteristics of new type airplanes and information on incidents or accidents that do not cause immediate termination of a flight. Pending the accomplishment of such rule-making action, the FAA encourages the development and use of flight recorders capable of retaining 25 hours of data.

The basis upon which the time of recorder operation is determined for retention purposes is changed from the Notice. The retention period proposed in the Notice was based on the flight recorder operating time specified in § 121.343(b), which is, ". . . from the instant the airplane begins the takeoff roll until it has completed the landing roll. . . ." This amendment allows the retention period to be based on the cockpit voice recorder operating time specified in § 121.359(a), which is, ". . . from the start of the use of the checklist (before starting engines for the purpose of flight) to completion of the final checklist at the termination of the flight." This change in the retention requirement allows the operation of both flight and voice recorders during the same period and permits simplification of recorder controls and operating procedure. It should be recognized, however, that extra tape may be needed for ground operation, such as testing, that is not done during the period upon which the retention of flight recorder data is based. Further, it should be noted that although the retention of recorded data may be based on voice recorder operating time, the flight recorder need only be operated as specified in § 121.343(b).

Notice 69–3 stated that the FAA has the subject of the standardization of the method of recording and readout under continuing study. However, in view of the standardization work underway by industry, the FAA is now of the opinion that further rule-making action on this subject will be unnecessary.

In response to a comment, we wish to point out that any recording and readout technique may be used, including the data compression technique, if the information obtained thereby is equivalent to that specified in new Appendix B. However, regardless of the recording technique used, accurate and prompt readout of data must be available in the event of an accident.

Several comments indicate misunderstanding of the requirement for time correlation of the flight recorder and communications between the airplane and air traffic control. The intent of this provision is to require time correlation of either the communications to or from the airplane, but not both.

As a result of comments on the Notice and several conferences with industry and NTSB representatives, certain changes have been made in § 121.343(a)(2), and Appendix B has been changed with respect to the nomenclature, range, system accuracy, and recording interval of the data which is to be recorded.

Roll rate, pitch rate, yaw rate, and angle of attack, which can be determined from other recorded data, and ambient air temperature have been deleted from § 121.343(a)(2) as adopted. However, for those operators who desire to furnish angle-of-attack data by recording it directly, appropriate specifications for angle-of-attack measurement are included in Appendix B.

The proposed engine thrust data range in Appendix B has been changed to require recording the full range of engine thrust in the forward direction only. With respect to reverse thrust, an indication of the stowed and the full reverse position of each thrust reverser is required.

In response to several comments requesting specific standards for the installation and operation of the under-water locating device, the FAA is preparing an advisory circular that will set forth one acceptable means of compliance. The agency plans to issue the advisory circular approximately six months after the effective date of these amendments. Accordingly, the date for compliance with § 121.343(f) has been changed from 3 to 3½ years after the effective date of these amendments to allow time for installing the device after issuance of the advisory circular.

In response to comments concerning the use of more than one flight recorder, the proposal is changed to require the under-water locating device to be secured only on or near the flight recorder that records time, altitude, airspeed, vertical acceleration, and heading. It will be noted that only one device for locating flight recorders under water is required for each airplane.

One comment recommended that the data erasure prevention means required by proposed § 25.1459(a)(5) be limited to those recorders powered from the airplane battery or from an independent source. The FAA agrees that the requirement for a means to stop the recorder and prevent data erasure within 10 minutes after crash impact should not apply to recorders powered solely from the airplane electrical generator system, and § 25.1459(a)(5) is changed accordingly.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, and for the reasons stated in Advance Notice 67-6 and Notice 69-3, Parts 25 and 121 of the Federal Aviation Regulations are amended, effective September 18, 1970.

These amendments are issued under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423) and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-26

Fire Detectors and Engine Power Response

Adopted: March 16, 1971 **Effective: April 23, 1971**

(Published in 36 F.R. 5490, March 24, 1971)

The purpose of these amendments is to expand the design and installation requirements for fire detector devices in transport category airplanes, to require a fire detector system in normal category rotorcraft, and to establish more specific requirements concerning engine response to throttle control movement under various load conditions.

These amendments are based on Notice 69-7, issued March 8, 1969, (34 F.R. 5020). Numerous comments were received in response to Notice 69-7 and changes have been made in the proposal based thereon. These changes are discussed hereinafter.

One of the comments stated that fire detectors should be capable of monitoring the worst fire foreseeable and suggested that this language be incorporated into § 25.1203. The FAA does not consider that such a change is necessary. The regulations now require that fire detectors be installed in each designated fire zone and in the combustion, turbine, and tailpipe sections in sufficient numbers and locations to ensure prompt detection of a fire. This regulation is not limited to any particular type of fire, but applies to all fires in the designated areas. It would, therefore, include the worst fire foreseeable. The commentator also requested that the regulation be changed to prevent the fire detectors from being rendered inoperative by a type of fire, such as blowtorching. The FAA is aware that there have been instances in which detectors were rendered inoperable due to blowtorching. However, this has occurred infrequently. Under this regulation, the detector system must still function in the event the sensor or wiring is severed at one point, unless there is a means to warn the crew of the severing, whether or not the severing results from "blowtorching". Moreover, if the system does become inoperative due to a short circuit in the system, a means is required to alert the crew to this condition. The FAA, therefore, believes that the matters raised by the commentator are already adequately covered and that the suggested changes to the proposal are unnecessary.

One commentator suggested that fire detector systems should provide both visual and aural fire warning, contending that visual lights are ineffective in sunlight and that taller pilots are unable to see some warning lights from the normal sitting position. The commentator also urged that all transport category aircraft be required to have installed the newer and more reliable types of fire detection equipment as they become available, and observed that some aircraft presently in service do not provide fire extinguishing for certain combustion heaters which burn JP-1 fuel and are located in the tail compartment, inaccessible to the crew in flight. With respect to the first comment, the FAA does not believe it is necessary to require both visual and aural fire warning indicators. So long as the type of warning means selected by the manufacturer provides prompt and effective warning of fire to the crew, either visual or aural means may be used. If both visual and aural means are needed to provide effective fire warning, then both means would have to be used. Further evaluation of the proposal has revealed that the term "alert" as used in the proposed § 25.1203(b)(3) may cause some confusion. The intent of the requirement was to provide a warning for the crew and this term is consistently used throughout the regulations. Therefore, the regulation has been revised to require a means to warn the crew in the event that a short circuit occurs. With regard to the second comments, the FAA does not believe it is either necessary or feasible to require that the newer fire detection equipment be installed in the older transport category airplanes. In many instances the installation of the newer detection systems in the older airplanes would be extremely burdensome, if not impossible. Moreover, the FAA is not aware that fire detection systems on older aircraft are inadequate or that they need to be replaced with the newer equipment. In any event, if an unsafe condition were found involving the fire detector system of any airplane now in operation, appropriate action, including an airworthiness directives, would be taken to correct that condition. Regarding the commentator's observation concerning JP-1 combustion heaters, it should be noted that the current airworthiness regulations (§ 25.859) do not require fire protection for all combustion heaters. Section 25.859 requires that combustion heater fire protection must be provided for the region surrounding the heater only if this region contains any flammable fluid system components (excluding the heater fuel system) that could be damaged by heater malfunctioning or could allow flammable fluids or vapors to reach the heater in case of leakage, or if the heater fuel system has fittings that, if they leaked, would allow fuel or vapors to enter this region. Thus, in any region surrounding a heater where the conditions covered in the regulation do not exist, fire protection would not be required. This rule would apply to the situation referred to by the commentator. A change in the current requirements is not considered necessary in the interest of safety.

After further evaluation in the light of various comments received, the FAA has determined that the proposed requirement that a fire detector remain in an operable condition in the event it is severed at one point is unnecessarily restrictive. The FAA has determined that it is not necessary in the interest of safety to require that a fire detector system remain operable after it has been severed at one point or, for that matter, after a short circuit, if there is a means to warn the crew that the system has been severed or that there has been a short circuit. The proposal has, therefore, been changed to require that there be a means to warn the crew in the event that the fire detector system does not continue to function as a satisfactory detection system after the sensor or the associated wiring has been severed at one point or after there has been a short circuit in the sensor or associated wiring.

Another commentator observed that single spot detectors would not meet the proposed requirements since they do not remain operable if severed at any one point, and stated further that the regulation would dictate the use of dual loop detector systems. However, in view of the change to the proposal discussed in the preceding paragraph, single spot detectors could be used if the fire detection system provided the required warning to the crew.

One commentator suggested that the term "fire detector system" be defined to include the sensors, control means, indicating panel, and associated wiring. The commentator also suggested that § 25.1203(b)(1) be changed to refer to the severing of sensors and associated interconnecting means. However, the FAA's recent evaluation of fire detector system failures has shown that only the fire detector sensors and associated wiring located in designated fire zones need to be protected from severing and that failures due to shorts are most likely to occur in designated fire zones. The proposal has, therefore, been revised to refer only to the "sensor or associated wiring within a designated fire zone".

The FAA has also determined on the basis of comments received, that the phrase "remain in an operable condition" does not accurately convey the intent of the proposal. Safety requires that the crew must be warned in the event that the fire detecting sensor or associated wiring in any designated fire zone is severed unless the system "continues to function as a satisfactory detection system." The proposal has been changed accordingly.

It was proposed to require a means to alert the pilot in the event of a short circuit in the detector system. However, after further consideration the FAA believes that it is not appropriate in the interest of safety to restrict the warning to the pilot and the regulation now provides for a means to warn the crew in the event of a short circuit.

Two of the comments pointed out that the proposal would require an alert in the event of a short circuit even though in a given case the short circuit might not impair the performance of the fire detector system. The FAA agrees that the proposal is not clear in that respect, and that it is not necessary in the interest of safety to require that the system provide an alert to the crew of any short circuit which does not render the detector system incapable of detecting a fire. The proposal has been changed accordingly.

Several comments objected to the proposed requirement that the fire detector be constructed or protected so that when it is in the configuration for installation it would withstand mechanical damage that might occur as a result of routine maintenance performed on the powerplant. The comments indicated difficulty with the scope of routine maintenance and with the requirement that the detector withstand mechanical damage. However, in view of the changes being made to the proposal permitting a warning to the crew in the event that a fire detector sensor or associated wiring is severed at one point, the FAA considers that the subject requirement is no longer necessary. Section 25.1203(g) as proposed in Notice 69-7, has been revised accordingly.

Some commentators contended that the present fire detector TSO (TSO-C11d) should be changed so that the required response time test will allow more than the presently prescribed 5 seconds for high alarm temperature sensors. One of the commentators also suggested that TSO-C11d allow for the effect of airframe structure on response time, and that a pre-flight check be required in order to verify the performance of the detector system if the system is not demonstrated to be unaffected by damage or age. With respect to the first comment, the FAA believes that the 5-second response time now permitted by TSO-C11d is the maximum that can be allowed consistent with safety. However, the TSO does provide for a higher initial temperature for high alarm temperature sensor tests, provided those sensors are used only in the corresponding high alarm temperature installation. Regarding the effect of airframe structure on detector response time, the TSO requirements pertain to the performance of the detectors separate from the many types of aircraft in which they may be installed. However, with respect to the commentator's suggestion, the FAA does not agree that the detector response time in the TSO should be increased to take into consideration the effect of airframe structure. Safety dictates that the TSO detector response time must be met with the detectors in the installed configuration and the proposal is unchanged in this respect. In regard to the last comment, while § 25.1203(d) presently requires that there must be a means to check the functioning of each fire detector circuit in flight, service experience has not indicated that there is a need to require a preflight check to verify performance of the detector system.

There was also a comment which recommended that the system remain in an operable condition or, in the alternative, that there be a means to warn the crew in the event of a break or short in a fire detector element. As previously pointed out, the proposal has been changed to provide for a crew warning unless the system continues to function as a satisfactory detection system after the severing or short circuit.

Upon further review of the proposed amendments to § 25.1203, and in view of some of the above comments, the arrangement of the section is being changed slightly in the interest of clarity. Therefore, that part of the proposed § 25.1203(g) requiring that fire detectors withstand vibration, inertia, and other loads is being incorporated into § 25.1203(b), where it is logically associated with the requirements concerning severing and shorting of the fire detectors.

In regard to the proposed new § 27.1195, one comment was received which urged that the proposed regulation be omitted from the final amendment. The commentator contended that the lower rate of engine failures, including engine fires, for turbine engine powered rotorcraft as compared to the rate for reciprocating engine powered rotorcraft shows that there is no need for the proposed requirement for fire detectors. The commentator also stated that the provisions in Part 27 requiring that the flammable fluid line and fitting in any area subject to engine fire conditions must be located or shielded to prevent fluid leakage on surfaces hot enough to ignite the fluid, provide a level of safety equivalent to that provided by the present § 29.1203, which requires fire detectors in transport category rotorcraft. Further, the commentator questioned whether the greater fuel load of turbine engine powered rotorcraft was a valid factor in requiring fire detectors, and maintained that engine fires can be detected by the pilot via normal engine instruments. The FAA does not agree that the proposed § 27.1195 is unnecessary. The FAA is not aware that the rate of engine failures, including fires, is lower for turbine engine powered rotorcraft and the commentator has submitted no data to substantiate this claim. In any event, the FAA does not agree that the present § 27.1183(a)(3) provides a level of safety equivalent to that provided by § 29.1203. Although § 27.1183(a)(3) does prescribe standards of safety for flammable fluid line and fitting leakage which are not now provided for Transport Category Rotorcraft, Part 29 is currently being amended in conjunction with other airworthiness Parts and the FAA is updating the standards for flammable fluid lines, fittings, and other components. Further, the additional hot surface areas of turbine engine poses a hazardous source for the ignition of leaking flammable fluids on turbine engine powered rotorcraft. It should be noted that § 27.1195 will apply only to turbine engine powered rotorcraft. The FAA does not agree that engine fires on Part 27 rotorcraft are detectable by the pilot through normal engine instruments and the commentator has submitted no data in support of this contention. Finally, the FAA notes that turbine engine powered rotorcraft have higher altitude performance capability than do reciprocating engine powered rotorcraft. The time required for an emergency descent and landing following an engine fire may thus be appreciably greater for turbine engine powered rotorcraft and could exceed the 5-minute period provided by § 27.861 for the protection of the rotorcraft structure, controls, rotor mechanism, and other essential parts in the event of powerplant fires. The immediate detection of turbine engine fires by means of a fire detector system is therefore required in the interest of safety.

A number of comments were received in regard to the proposed §§ 33.73 and 33.89. Two commentators questioned whether the maximum rated power or thrust specified in § 33.73 would include the augmented thrust resulting from after-burning. The intention of the proposal was that the takeoff power or thrust rating used in showing compliance with that section be a rating selected by the applicant for the certification of its engine. However, if the applicant elects to use augmented thrust in establishing the rated thrust of the engine for certification, the augmented thrust need not be used in showing compliance with § 33.73. The manufacturer will have the option of using either augmented thrust or unaugmented thrust in demonstrating compliance with § 33.73, and proposed § 33.73(b) has been revised to make this clear. In addition, after further study it has been determined that the word "maximum" as used in the proposed § 33.73 is not necessary and may cause confusion. The definitions in Part 1 of the FAR's refer to "rated takeoff power" and "rated takeoff thrust", and in the interest of consistency, the phrases "maximum rated power or thrust" and "maximum rated takeoff power or thrust" in § 33.73 have been changed to "rated takeoff power" and "rated takeoff thrust".

Various changes to the wording of proposed § 33.73(b) were recommended to make provision for the difference in power management of the primary propulsion systems of fixed wing and rotary wing aircraft, and to improve compatibility between Part 33 requirements and the landing climb requirements of Part 25. The FAA does not agree that the suggested changes are necessary. The language of proposed § 33.73(b) was selected to represent the minimum power setting to be used in the certification of all engines. Furthermore, § 33.73(b) is a design requirement for a specific engine thrust response capability without relation to the many power management systems that may be used. Insofar as compatibility of the new regulation with Part 25 is concerned, the FAA sees no conflict. Section 25.119 allows 8 seconds between the movement of the power lever from minimum flight idle to maximum takeoff position and demonstration of the required minimum climb gradient capability. The extra 3 seconds provided by § 25.119 over the 5 seconds provided by § 33.73(b) should be adequate to provide for any engine power losses due to engine installation, accessory loads, and air bleed. In any event, it is the airframe manufacturer's responsibility to select an engine having adequate thrust response characteristics to match the expected performance characteristics of the airplane and to comply with the regulations, including § 25.119. The intent of § 33.73(b) is to establish minimum engine thrust response characteristics, and not to deal with airplane performance requirements.

Several comments were received in response to the proposed § 33.89. One commentator suggested that § 33.89(c) be reworded to incorporate the more precise definition of idle power and the 5 second response time provided in § 33.73(b). The agency does not agree with the suggested change. Section 33.73(b) prescribes design requirements, whereas § 33.89 is concerned with operational test requirements. From the standpoint of engine operation, the precise idle power setting used to demonstrate design power or thrust response time is not appropriate, since the variables introduced during the operational test may cause the power or thrust produced by the engine when the power lever is at the specified idle power setting to be somewhat different from the design idle power or thrust. Requiring this test to be run with prescribed power lever positions will result in more realistic test times. The commentator also suggested that a new paragraph (d) be added to include engine operation with variable geometry inlet and exhaust nozzles, and with thrust augmentation. However, this comment is beyond the scope of Notice 69-7 and will be considered in future revisions to Part 33. Another commentator suggested that the requirements of § 33.89(c) be deleted, except for subparagraph (c)(1), and be transferred to Subpart E of Part 33 as design and construction standards since the test facilities necessary to make the determinations required under § 33.89 are not widely available. The FAA does not agree that the requirements of § 33.89 should be transferred to Subpart E. However, the FAA is aware that the necessary test facilities for power extraction may not be available, and analytical means could be used in lieu of the test prescribed for power extraction by §§ 33.89(c)(2) and 33.89(c)(3). Therefore, a new paragraph (d) has been added to permit the use of analytical means for the tests prescribed by §§ 33.89(c)(2) and 33.89(c)(3) for power extraction if necessary test facilities are not available.

Interested persons have been given an opportunity to participate in the making of these amendments. All relevant material submitted has been fully considered.

In consideration of the foregoing, Parts 25, 27, and 33 of the Federal Aviation Regulations are amended, effective April 23, 1971.

These amendments are made under the authority of Sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-27

Anticollision Light Standards

Adopted: July 1, 1971 **Effective: August 11, 1971**

(Published in 36 F.R. 12970, July 10, 1971)

The purpose of these amendments is to (1) permit the use of either aviation red or aviation white anticollision light systems; (2) expand the chromaticity-coordinate range for aviation white; (3) increase the minimum effective intensities for anticollision lights installed on all aircraft to be type certificated after the effective date of these amendments; and (4) require that within one year after the effective date of these amendments all powered civil aircraft with standard airworthiness certificates have an approved anticollision light system for night flight.

These amendments are based on a notice of proposed rule making (Notice 70-21) published in the Federal Register on June 4, 1970 (35 F.R. 8665). Numerous comments were received in response to the Notice and except to the extent that a comment merely repeated issues which were discussed in detail and properly disposed of in the Notice, the FAA's disposition of those comments are set forth hereinafter.

Several comments objected to the requirement that all aircraft flying at night must be fitted with an approved anticollision light. One commentator pointed out that certain operators of small aircraft may fly for a few minutes after dark but only to reach a destination and that such operators should not be burdened with an expensive anticollision light requirement. Another commentator took a similar position with respect to aircraft that are operated at night only in local areas or only in an emergency. The FAA does not agree. With proper flight planning, flight after dark can usually be avoided without inconvenience. Moreover, any aircraft operating at night without an approved anticollision light constitutes a hazard regardless of whether it is being operated in a local area or in an emergency.

One commentator indicated that the FAA may have underestimated the problems associated with removal of the red filter on the anticollision light on existing aircraft. The commentator pointed out that it may be impossible to meet the current field-of-coverage requirements because of the need to mask the unfiltered light to eliminate back-scatter. While the FAA recognizes this problem, it should be noted that it was not proposed to require anyone to remove the red filters on existing aircraft. Moreover, if an operator elected to do so, he would not be required to meet the new intensity requirements. Furthermore, he could relocate the light to minimize the back-scatter problem.

There were numerous comments received in response to Notice 70-21 which recommended changes to the regulations in addition to those proposed in the Notice. In this connection, it was recommended that the current field-of-coverage requirements be extended; that the existing flash-frequency requirements be modernized; that exterior minimum intensity requirements be increased beyond the values proposed in the Notice; that a red anticollision light be required for nighttime use and a white anticollision light be required for daytime use; and that the operating rule in Part 91 also cover aircraft other than powered civil aircraft with standard airworthiness certificates. While some of these recommendations may have merit, they are beyond the scope of Notice 70-21. However, the FAA is now in the process of investigating and evaluating these recommendations to determine which merit further rule-making action.

One commentator suggested that final action on Notice 70-21 should be deferred until the current FAA/NASA research on aircraft exterior lighting is completed. The FAA does not agree. The changes to the anticollision light requirements proposed in Notice 70-21 are very limited in scope and they are not being dealt with directly in the referenced research. The additional rulemaking that may be generated by the FAA/NASA research would be concerned with the entire area of aircraft exterior lighting and no useful purpose would be served in further delaying the proposed changes.

Several commentators expressed the view that the display of white condenser-discharge anticollision lights significantly reduces the frequency of bird strikes in flight. One respondent submitted statistical data in support of its position and urged that the display of white condenser-discharge lights be made mandatory. The FAA does not agree with these comments. After a thorough review of the data presented, the FAA does not believe that a significant correlation between display of white condenser-discharge lights and frequency of bird strikes has been shown. However, the FAA is continuing its investigation in this area and if further studies reveal that a correlation does exist, it will be the subject of future rule-making action.

Various comments pointed out that while the notice proposed to require an "approved" anticollision light system, it did not specify the standards for such approval. This appears to be a problem only with respect to anticollision light systems that would have to be installed on aircraft type certificated under airworthiness standards which did not incorporate anticollision light standards. For large aircraft and for certain small aircraft, the operation rules have long required anticollision lights and the airworthiness regulations have long contained standards for such lights. Thus, lights meeting the applicable airworthiness standards are approved lights. In addition, numerous airplanes have, in the past, had anticollision light systems installed voluntarily. All of these systems were approved by the FAA and they continue to be approved. The question as to the identification of approved anticollision light systems arises with respect to the installation of anticollision lights required by this amendment to be installed on aircraft which were certificated under airworthiness standards that did not contain standards for anticollision lights. The FAA is aware that in most instances, the modifications to the older aircraft that would be necessary in order for the anticollision lights to meet the higher intensities proposed in Notice 70-21 would be extensive and may, in certain instances, be prohibitive. This was recognized in the Notice and it was not intended that the older aircraft should be required to meet the higher intensities set forth in this amendment. Therefore, the proposal has been revised to make it clear that for the initial installation of anticollision lights on the older aircraft (those for which type certificates were applied for or issued prior to the effective date of this amendment), the anticollision lights would only need to meet the anticollision light standards in Parts 23, 25, 27, or 29, as applicable, effective immediately prior to the effective date of the amendments contained herein.

Another comment expressed an objection to the proposed increase in the intensity level of anticollision light systems for future aircraft on the grounds that for small aircraft using red anticollision lights, power requirements would be unreasonable, service life short and reliability low, and that for small aircraft using the white anticollision lights, it would not be possible to shield them for purposes of back-scatter without a reduction in the required field-of-coverage. The FAA is aware that for red anticollision lights more electrical power would be needed to meet the new requirements than has been provided in the past. However, the FAA believes that this additional power capacity can be provided on future aircraft at reasonable cost, without incurring a low-service-life or low-reliability penalty. Moreover, a manufacturer would now have the option of installing a white anticollision light, thereby eliminating the power problem. The back-scatter problems referred to by the commentator can be solved without diminishing the field-of-coverage by installing a system consisting of three lights, one at each wing-tip and one on the tail.

Finally, one commentator urged the FAA to specify, as part of the revision to the intensity standards for anticollision lights, a minimum infra-red signal content for use with PWI systems now under development. This matter was discussed in some detail in Notice 70-21 and the FAA maintains its view that it would be premature to require a minimum infra-red signal content until current evaluations by the FAA of the PWI system concept on civil aircraft have been completed. This does not, however, prohibit the incorporation of infra-red signal content in any anticollision light system.

In consideration of the foregoing, Parts 23, 25, 27, 29, and 91 of the Federal Aviation Regulations are amended, effective August 11, 1971.

These amendments are issued under the authority of sections 313(a), 601, 603, and 604 (49 U.S.C. 1354, 1421, 1423, and 1424), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-28

Emergency Slide Lighting

Adopted: August 19, 1971 **Effective: September 25, 1971**

(Published in 36 F.R. 16899, August 26, 1971)

The purpose of these amendments to Parts 25 and 121 of the Federal Aviation Regulations is to exclude from the emergency lighting operating requirements, emergency slide lighting systems that serve only one assist means, are independent of the airplane's emergency lighting system, and are automatically activated when the slide is deployed.

These amendments were proposed in Notice 70-48 issued on December 18, 1970, and published in the Federal Register (35 F.R. 250) on December 25, 1970.

Parts 123 and 135 of the Federal Aviation Regulations require compliance with the emergency lighting requirements of § 121.310(d). Therefore, these amendments apply to air travel clubs conducting operations under Part 123 and Part 135 certificate holders using large, passenger-carrying airplanes.

Two of the comments received to Notice 70-48 contained unqualified support for the proposal, and another suggested that the proposal would not increase the level of safety above that provided by the present regulations. The agency is of the opinion, however, that the regulations must be responsive to improvements in technology and should not exclude those developments which provide at least a level of safety equivalent to that now required.

Another comment suggested that slide-illuminating-lights be mounted on the airplane external to the slide, and connected so that they can be used to illuminate the area below the associated exit should the slide fail to deploy. Since this recommendation is outside the scope of the proposal, it cannot be included in this regulatory action.

One comment noted that the proposal makes no provision for manual activation of the lights and stated that this would not allow a backup for the automatic activation, nor allow the system to be checked by a crewmember prior to flight. The FAA believes that since the slide lighting systems covered by the amendment are periodically checked and maintained, they provide an adequate level of safety without provisions for manual activation. However, if service experience should indicate otherwise, further regulatory action will be taken. In this connection, it should be pointed out that the amendments do not prohibit the use of slide lighting systems which provide both manual activation and automatic activation upon deployment.

Two of the comments received poinit out that the FAA has approved at least one slide lighting system that is activated automatically upon deployment in which both the light and power source are mounted on the exit door, external to the slide. The commentators suggest that while this system is not "wholly contained" in the slide as that term is used in the Notice, the system does satisfy the intent of the proposal, and should be auhorized by the regulations.

The FAA agrees that the slide lighting systems proposed to be excepted need not be wholly contained, but they must serve one slide only, be independent of the airplane's main emergency lighting system, and be automatically activated when the slide is deployed. Accordingly, the amendments to §§ 25.812(e) and 121.310(d) are changed from the proposal in the Notice to reflect this means of compliance. Consistent with these changes, § 25.812(g)(2) is also amended to achieve consistency within the regulations.

Interested parties have been given an opportunity to participate in the making of these amendments, and due consideration has been given to all comments received.

Since the changes made by this amendment to the wording of the proposal in Notice 70-48 are minor in nature and impose no additional burden on any person, I find that further notice and public procedure relating to them are unnecessary.

In consideration of the foregoing, and for the reasons given in Notice 70-48, Parts 25 and 121 of the Federal Aviation Regulations are amended, effective September 25, 1971.

These amendments are issued pursuant to the authority contained in sections 313(a), 601, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1424), and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25–29

Emergency Locator Transmitters

Adopted: September 14, 1971 Effective: October 21, 1971

(Published in 36 F.R. 18716, September 21, 1971)

These amendments to Parts 25, 29, 37, 91, 121, and 135 of the Federal Aviation Regulations implement Section 31 of Public Law 91–596, achieve uniformity in the terminology used therein, and update requirements and standards for the manufacture, installation, airworthiness, and operation of emergency locator transmitters required on airplanes operated in air commerce. In addition, the current requirements of Part 121 (also applicable to air travel club operations conducted under Part 123) concerning emergency signaling devices required for extended over-water operations and operations over uninhabited terrain, are updated. Finally, a requirement for an emergency locator transmitter for extended over-water operations has been added to Part 135.

These amendments are based on a Notice of Proposed Rule Making, Notice 71–7, published in the Federal Register on March 13, 1971 (36 F.R. 4878). Nearly 200 commentators responded to the Notice, and based on the views they expressed and further examination by the FAA, several changes have been made to the Notice. The analysis of the comments has been broken down into three broad categories: those comments which are general in nature or which speak to the general objective of the Notice; those comments submitted in direct response to the FAA request for comments addressed to the 75 milliwatt power standard; and those comments making specific recommendations or stating specific objections. The changes made by the FAA independent of any public comment will be discussed within this framework.

General Comments. Approximately 50 commentators objected to any requirement for emergency locator transmitters for the following reasons: past experience with such locator devices indicates that they seldom prove helpful in locating a lost airplane and thus their benefit does not justify their cost and weight; installation and use of an emergency locator transmitter should be optional with the operator—those who are willing to take the risk of operating without a transmitter should be allowed to do so; required use of the transmitter would generate a tremendous search and rescue workload, which combined with false alarms, would cause air rescue personnel to lose their effectiveness and enthusiasm; emergency locator transmitters are not reliable; and finally, there is no need for an emergency locator transmitter if the pilot files a flight plan and follows it, because when an emergency occurs, he has ample time to notify the nearest FAA facility and report his position.

As pointed out in the Notice, this regulatory action has been taken in response to a mandate from Congress (Public Law 91–596, amending section 601 of the Federal Aviation Act of 1958 (49 U.S.C. 1301 et. seq.)), and as such, the FAA has no authority to grant exemptions from that section. With regard to the matter of reliability, the FAA has no reason to believe that emergency locator transmitters designed to meet the standards adopted herein would not be adequately reliable. With regard to flight plans, the FAA believes that rather than being a substitute for an emergency locator transmitter, the flight plan can be effective adjunct to such equipment. To this end the agency is considering rule-making action to require the use of flight plans for all operations with large U.S. registered civil airplanes and all turbine powered multiengine U.S. registered civil airplanes when operated in the United States, and which are not subject to Parts 121, 135, or 137.

Numerous comments were received recommending that the FAA exempt certain classes of airplanes, which were not exempted by Public Law 91–596 nor the proposals in Notice 71–7, from the emergency locator transmitter requirements. Specifically, it was recommended that the following be exempted: private airplanes; air taxi airplanes; amateur-built airplanes; antique airplanes; turboprop and multi-reciprocating-engine airplanes operated by a two-man crew; airplanes undergoing "export ferry"; airplanes that carry ATC transponders; and airplanes that do not operate over mountainous areas, sparsely populated areas, nor wide expanses of water.

As previously mentioned, the FAA does not have the power to expand the class of airplanes exempted by Public Law 91–596 from compliance with the emergency locator requirements of that law. This also applies to the comment of the ATA which contends that it was the intent of the statute to exempt all operations conducted by air carriers, not just operations conducted under Part 121, and thus recommends that charter operations, training flights, and ferry flights, when those operations are conducted in propeller-type airplanes, be exempt as well.

Several comments were received recommending that the FAA adopt a rule requiring that flight crewmembers of air carrier and military aircraft monitor the emergency frequencies during flight time, and that each emergency signal received be reported to the nearest FAA facility. Without such a requirement, these commentators contend, a requirement for an emergency locator transmitter is unjustified.

Although the air carriers have indicated a willingness to monitor emergency frequencies, and most military aircraft are equipped for this purpose, the FAA does not believe that requirements in this regard are necessary. Aircraft routinely used for search and rescue are equipped for homing in on emergency locator transmitter signals. In addition, emergency frequencies will be monitored in all FAA flight inspection aircraft and appropriate monitoring capability is planned for future installation in certain strategic Forest Service watchtowers. The FAA considers this monitoring capability to be adequate for the present. Additional rule making may be undertaken, however, if experience in service indicates the need for supplementary monitoring.

The proposal to bring the emergency locator transmitter under the Technical Standard Order (TSO) procedures of Part 37 was objected to by several commentators. These commentators recommended that emergency locator transmitters should be tested by independent test laboratories, the National Bureau of Standards, or the FAA, rather than permit the manufacturer to, in effect, certify his own product. It was contended that under the TSO system, manufacturers will use incorrect measuring techniques and tamper with test results.

The FAA does not agree with this comment. The TSO system has been applied successfully in the past to hundreds of manufacturers of such airborne electronic equipment as radio navigation equipment, ATC transponders, radar altimeters, and various flight instruments. There is no reason to believe that it cannot be applied equally as well in this case. Although the FAA, under the TSO system, does not require testing by an independent laboratory, it does review the technical data submitted by the applicant (manufacturer), and also monitors quality control to ensure compliance with the standard.

Two commentators requested that the proposed emergency locator standards be revised, or replaced, in order to accommodate their own emergency signaling concepts. On the basis of the information submitted by these commentators, the FAA does not believe that there is sufficient justification to change the standards applicable to emergency locator transmitters, which were developed after exhaustive discussions among industry and government organizations.

Several commentators pointed out that FCC rules require that each airplane fitted with an emergency locator transmitter must also be equipped with a radio transmitter and receiver that operate on at least one other frequency. In addition, the airplane must have an FCC Station license and the operator must have an FCC operator's license. Consequently, these commentators contend, they will have to install, in addition to the emergency locator transmitter, expensive radio equipment that FAA does not require and that they do not need. Further, they would have to acquire both a station and an operator's license and pay the associated fees.

The FAA has been informed by the FCC that it plans to issue an amendment to its regulations, before the earliest effective date of Public Law 91-596 (December 30, 1971), that would permit the installation of an emergency locator transmitter in an airplane, without requiring the operator to obtain an FCC Station license or to acquire additional radio equipment, if the transmitter does not have voice transmission capability. This FCC rule making should solve most of the problems posed by these commentators. An operator's license would still be required, however.

Several commentators pointed out that the Notice made no mention of a voice communication capability in the emergency locator transmitter, and contended that such capability should be made mandatory, or at least permitted. These commentators believe that this is a vital consideration, for it would enable a downed pilot to direct search and rescue aircraft to the scene and communicate his needs to them. The FAA does not agree that a voice communication capability is an essential feature which warrants rule-making action. However, the FAA has no objection to an optional feature such as the voice capability, provided all required standards adopted herein are met. Prospective users of emergency locator transmitters having this capability should consult FCC regulations concerning voice-modulated transmitters.

Several commentators expressed concern that emergency locator transmitters might be activated inadvertantly and suggested various ways of preventing such inadvertant activation, or of detecting it quickly after it occurs. The FAA is reviewing these suggestions to determine whether further rule making should be undertaken.

There were numerous other comments of a general nature received which were outside the scope of the Notice and thus are not discussed herein. However, it should be pointed out that as the state-of-the-art develops with regard to emergency locator transmitters, the FAA will undertake additional rule-making actions to implement necessary changes in technology and practice.

The 75 Milliwatt Power Standard. Notice 71-7 requested comments addressed specifically to the 75 milliwatt peak effective radiated power standard developed by the Radio Technical Commission for Aeronautics (RTCA) for emergency locator transmitters. As stated in the Notice, the 75 milliwatt standard was proposed because it would provide a transmission range of 50 nautical miles even where conditions at the site were unfavorable. Twenty comments were received in response to this point, and 14 recommended adoption of the standard, two recommended an increase in power, and four recommended a decrease. These comments are discussed below.

Those commentators recommending an increase in power contended that lost airplanes are often far off course thus necessitating a signal strong enough to be received by ground stations (to this point, one commentator recommended a power standard of 300 milliwatts, the other a power standard of 500 milliwatts). It was stated that an increase to 500 milliwatts, combined with a 1:3 on-off duty ratio for the transmitter would provide maximum range per unit battery weight.

Those commentators recommending a decrease in power contended, generally speaking, that a lower value for peak effective radiated power would reduce the cost and size of the transmitter. Thus, one commentator stated that reduction in power to 7.5 milliwatts would result in a ten-fold increase in transmission duration for a given battery weight or, alternatively, in a ten-fold reduction in battery weight for a given duration of transmission. Such a transmitter would provide a 16-mile transmission range which would be adequate for the purpose. For similar reasons, other commentators recommended a reduction to 25 milliwatts, or adoption of the lower radiated power level currently specified by Canadian regulations.

The FAA has carefully reviewed all comments submitted in regard to this matter, as well as FAA findings, and has concluded that the 75 milliwatt power standard represents a reasonable compromise and is realistic with regard to effectiveness, cost, and weight.

Comments of Specific Recommendation. Numerous specific recommendations and objections were made in response to Notice 71-7, and those within the scope of the Notice are discussed below in the order the proposals on which they are based appeared in the Notice, and, where possible, in connection with specific section numbers.

Section 25.1415(d) and 29.1415(d). Three commentators recommended that more than one survival type emergency locator transmitter be required on aircraft certificated for ditching. One recommended that two transmitters be carried since ICAO Annex 6 requires two. Another recommended that there be one for each life raft because seldom are all life rafts deployed after a ditching. Based on the service record to date, the FAA does not believe that it is necessary to require that more than one life raft be equipped with a survival type emergency locator transmitter.

Section 37.200(b)(1). Several commentators noted that the proposed standard for personnel type emergency locator transmitters (DO-145) permits the use of self-contained antennas that must be manually deployed. The point was made that should the occupants be incapacitated, or merely forget to deploy the antenna, a sharp reduction in the strength of the signal would result. Moreover, this kind of personnel emergency locator transmitter, in its normal stowed position, is screened by the aircraft's skin such that its signal strength is further reduced, and the antenna radiation pattern is distorted. To remedy these situations, it was recommended that these transmitters meet the radiated power output, and omnidirectional radiation pattern requirements of DO-145, as mounted in the airplane. Another recommendation suggested the FAA prohibit the use of antennas that must be deployed.

Self-contained antennas that must be manually deployed have been an accepted feature of hand-held communication receivers and transmitters for many years. The FAA believes that only a small percentage of pilots would be unable, or forget, to deploy the antenna after a crash landing. However, even in that case, tests have indicated that emergency locator transmitters located inside the airplane, with antennas either not deployed or only partially deployed, are still capable of a measure of useful performance. Furthermore, portable emergency locator transmitters with protruding fixed antennas may be a hazard to persons in the crash situation.

Section 37.200—Paragraph 2.2.1 of DO-145, 146, and 147. It was recommended that the frequency requirements be revised to permit operation on either 121.5 or 243.0 MHz, because many emergency locator transmitters currently in service operate on only one of these frequencies, and this is sufficient. The FAA believes that transmission on both frequencies is essential to successful operation of the emergency locator system, which is dependent upon full utilization of available civil and military monitoring capability.

Section 37.200—Paragraph 2.2.2 of DO-145, 146, and 147. With regard to the type of signal modulation required, it was recommended that an upward sweep be permitted as well as the proposed downward sweep because the latter is more costly and because both are readily identifiable and in fact, sound alike.

The proposal for a downward sweep tone was based upon an FAA determination that such a tone would provide a unique, recognizable, attention-getting signal that could be distinguished from background noise. We believe that to permit an upward sweep as well would only serve to lessen these advantages. The FAA is not persuaded that an upward sweep would cost less, nor that it sounds the same as a downward sweep.

Section 37.200—Paragraph 2.2.3 of DO-145, 146, and 147. It was recommended that the minimum modulation duty cycle be reduced from 33 percent to 10 percent, the commentator contending that the higher standard serves no useful purpose, but merely increases cost; whereas the lower standard would not adversely affect the performance of the transmitter. Another commentator suggested that an average modulation duty cycle be prescribed with a standard between 25 percent and 75 percent without specifying an instantaneous modulation duty cycle; or, alternatively, an average modulation duty cycle between 33 percent and 67 percent with an instantaneous modulation duty cycle between 10 percent and 90 percent. It was contended that such standards would result in an increase in power of weak signals, and an increase in the effectiveness of search operations because it would be apparent when the signal strength is increased or decreased.

The proposed modulation duty cycle was developed by the RTCA and the FAA as a practical compromise among several possibilities, such as those mentioned by the commentators. From the information submitted by these commentators, the FAA is not persuaded that any of the standards suggested by them would provide any significant improvement.

Section 37.200—Paragraph 2.2.4 of DO-145, 146, and 147. Several commentators contended that cost could be reduced and battery life increased if the transmitter duty cycle requirement were revised to permit interruption of the carrier. One commentator suggested a transmitter duty cycle of between 100 percent and 33 percent, with an "off" period not to exceed 0.75 seconds. Another suggested that the "on" period be not less than two complete audio sweeps, and that the "off" period not exceed two seconds, or two times the "on" period, whichever is less. This commentator contended that this type of interrupted transmission has been proven to be more effective than the conventional swept-tone signal and that the FAA has recognized this in TSO-C61a.

This standard was selected from several alternatives by the RTCA, with FAA participation. It was found that these "interrupted-carrier" transmissions lower the reliability of the emergency locator transmitter and complicate the task of the search receiver, thereby reducing the effectiveness of the transmitter. On the basis of the information submitted, the FAA is not persuaded that other transmitter duty cycles would improve transmitter performance.

Section 37.200—Paragraph 3.1 of DO-145. One commentator recommended that the low operating temperature be reduced from 0° C. to −20° C. since personnel type emergency locator transmitters are to be attached to the airplane (proposed § 91.52(b)(2)) as is the case with automatic-type transmitters which are required to meet the −20° C. standard.

The FAA agrees that personnel type emergency locator transmitters may be required to operate at temperatures below that prescribed in DO–145. Accident records indicate that a significant number of accidents have occurred in ambient temperatures between 0° C. and −20° C. To assure effective performance in foreseeable conditions, the "Low Operating Temperature" requirement has been changed to −20° C., and a concomitant change to the low temperature required for the temperature variation test, as prescribed in DO–145, from −20° C. to −40° C. has been made.

Section 37.200—Paragraph 3.1 of DO–145, 146, and 147. Another recommendation concerning temperature standards suggested that the maximum high operating temperature specified in this paragraph be increased from +55° C. to +71° C., because, it was contended, solar heating can raise the temperature 35° C. above the ambient. The FAA considers the +55° C. figure to be realistic and reasonable based on the probability of exposure to high temperature in service.

Section 37.200—Paragraph 3.4(a) of DO–145, 146, and 147. One commentator recommended that the FAA replace the proposed maximum g. level with the military standard, Curve IIIA of Mil–E–5400, Fig. 2, because the proposed maximum g. level was unnecessarily high, and because the military standard is adequate in military airplanes, which have vibration stresses significantly higher than civil airplanes.

The proposed maximum g. values were developed to ensure reliable operation after prolonged exposure to severe vibration and shock environments. The FAA has no reason to believe that the vibration environment in civil aircraft is necessarily less severe than that in military aircraft, thereby justifying a lesser standard. The FAA's views in this regard apply to other comments discussing the g. standard for other types of transmitters.

Section 37.200—Paragraph 1.9(a) of DO–147. It was recommended that the prohibition against sharp edges or projections on automatic-fixed type emergency locator transmitters be deleted because such transmitters must be installed in the tail section of the airplane where it is not accessible to the cockpit. Regardless of the location where the emergency locator transmitter is attached, the FAA believes that a prohibition against sharp edges and projections is necessary for all transmitters. Although fixed and deployable automatic type transmitters must be attached as far aft as practicable, there is no assurance that they would not be located where they could injure occupants or damage inflatable survival equipment.

Section 37.200—Paragraph 3.5 of DO–147. One commentator recommended that the temperature range specified in this paragraph be changed from a range of −40° C. to +55° C. to a range of −20° C. to +55° C. to make it consistent with paragraph 3.1 which prescribes this latter range as the operating temperature range for the subject transmitters. The FAA does not agree with this comment, because the test requirements of paragraph 3.1 are different than those of paragraph 3.5 with a corresponding difference in temperature requirements.

Section 37.200—Appendix A, Part II, Section T–2, Step 5a of DO–145, 146, and 147. A commentator recommended that the transmitter peak effective radiated power test prescribed in this step be revised to permit the use of a quarter-wave-length element surrounded by three quarter-wave-length radials spaced 120° around its base. It was contended that this arrangement would match the 50-ohm output impedance of most signal generators, whereas the arrangement prescribed in Step 5a would have a mismatching impedance of 25–30 ohms.

The FAA sees no compelling reason to adjust its test procedure to facilitate an impedance match with signal generators. Any mismatch that exists must be accounted for under the referenced provision in DO–145, 146, and 147.

Section 37.200(c)(1). Several commentators recommended that the additional performance standards for automatic activation prescribed in this proposal be deleted entirely. A discussion of the various reasons for this position, and the corresponding FAA response follows. Those comments already discussed which are applicable to this proposal are not dealt with further.

It was contended that the automatic activation feature on most existing emergency locator transmitters is either too "tender" or too "stiff". In the case of the former, false alarms result; in the case of the latter, the transmitter may not be activated in a crash.

In addition, experience in Alaska, it is argued, has shown that g.-switches are activated by moderately hard landings, with the resulting operation of the transmitter going unnoticed by the pilot, thus running down the battery and rendering the transmitter useless.

The proposed automatic activation standard was developed after a thorough examination of past service experience with devices of this kind. The FAA believes that emergency locator transmitters designed to that standard will not be activated during a hard landing, nor will they fail to activate during a crash landing. However, to help prevent inadvertant or accidental activation, a requirement for a switch guard has been added in new subparagraphs (c) (4) and (c)(5). The guard is required for all personnel, automatic portable and survival type emergency locator transmitters, which use a manual activation switch. In addition, the guard is required for all automatic deployable type emergency locator transmitters using a remote activation switch.

Canadian aviation authorities have recommended that the emergency locator transmitter not be turned on for 24 hours after a crash because it would take that long before it could be determined that an airplane was lost or where it might be. The FAA does not agree. In many areas, the emergency signal could be detected by aircraft flying normal routes and a search could be initiated. A 24-hour delay in some cases could prove fatal.

Some commentators contended that an automatic portable emergency locator transmitter, as described in DO-147, could adequately perform the functions of an automatically activated personnel type emergency locator transmitter, and thus there is no need for the latter. In this regard, it should be noted that the standards, as proposed in Notice 71-7, for automatic portable type emergency locator transmitters are, in several respects, more severe than those proposed for the personnel type. The FAA sees no justification for applying these higher standards to all users, as suggested.

In addition to those comments which recommended that the standards of § 37.200 (c)(1) be deleted entirely, several comments on specified proposals in § 37.200(c)(1) were received. A discussion of them follows.

Several commentators pointed out the typographical error in subparagraph (c)(1)(i) prescribing a force of 5.0±2.0 g. The correct force standard should read $5.0\ {}^{+2}_{-0}$g., and this is adopted herein. The FAA has found, after considerable experience with crash-activated devices, that an inertia limit below 5g. leads to "nuisance tripping" during hard landings or when the taxiway is rough.

Two commentators recommended that the time duration standard of 11 milliseconds prescribed in subparagraph (c)(1)(i) be changed to $11\ {}^{+5}_{-0}$ milliseconds to provide a practical manufacturing tolerance. The FAA agrees with this comment, and accordingly subparagraphs (c)(1)(i) and (iii) have been changed to prescribe an $11\ {}^{+5}_{-0}$ millisecond standard. In addition, it has been necessary to make a similar change, by way of exception in § 37.200(b)(2)-(4), to the standard as prescribed in DO-145, 146, and 147.

Several commentators recommended that a "g.-versus-time" curve, with a defined minimum g. value be established in place of the limits proposed in § 37.200(c)(1)(i), contending that impact switch characteristics necessitate a greater number of force/time points for design. It was argued that this type of standard would define the desired severity of crash irrespective of airplane structure, location of the emergency locator transmitter, or kind of crash.

The "g.-versus-time" alternative was considered by the FAA, but we concluded it would be too restrictive and unnecessary to provide a minimum level of safety. The g. value proposed by these commentators could lend to "nuisance tripping."

Another commentator recommended that § 37.200(c)(1) be revised to permit use of "deformation sensors", installed in the nose, wing, or other vulnerable part of the airplane. Such sensors, it was contended, have been used successfully in many military applications. The FAA agrees with this comment, pointing out that the note following paragraph 2.3.1 of DO-147 permits this alternative means of activation. Accordingly, the substance of that note has been added to § 37.200(c)(1).

Another alternative for activation, based on the combined use of a ram-air switch and an impact switch, was recommended. Under this arrangement, the emergency locator transmitter would transmit only when the impact switch is activated following flight of the aircraft, thus reducing, the commentator contended, the possibility of inadvertant activation. The FAA considers this approach unnecessarily complex. Moreover, it appears that it could prevent needed activation of the transmitter in some circumstances.

Section 37.200(c)(2). Numerous comments were addressed to the proposal requiring a manually activated test circuit, and the majority of them recommended deletion of this requirement. The points raised in these comments and the information submitted with them indicate that due to unnecessarily complex design and functional problems, and questionable benefits to the user, this requirement is not practical at this time. Accordingly, proposed § 37.200(c)(2) has been deleted.

Section 37.200(c)(3). Several commentators, largely manufacturers of emergency locator transmitters, responded to the marking proposals of this subparagraph, and the majority of them recommended they be deleted. Generally speaking, the bases for this position were the problems involved with obtaining battery manufacturer cooperation, and the fact that the required dates may mislead the user because they may not be a true indicator of available battery power. Upon examination of the points raised by these commentators, the FAA agrees that a requirement for the marking of date of manufacture is of questionable value, and believes further that the marking requirements of §37.200(f)(1) (battery replacement date) and § 91.52(d) are adequate to ensure operable power sources. Accordingly, the first sentence of § 37.200(c)(3), as proposed, has been deleted.

Several commentators addressed recommendations to the proposed requirements of § 37.200(c)(3) regarding battery electrical connections, contending that there is no reason why spring contacts (prohibited in the Notice), if properly designed for this application, could not be used. Furthermore, it was stated that special connection requirements serve only to increase battery cost and thereby make it more difficult to keep spares available.

The FAA is persuaded that battery connections which rely on spring force alone are not necessarily subject to failure. Accordingly, the last sentence of §37.200(c)(3), as proposed, has been deleted.

Section 37.200(d). One commentator recommended that this paragraph recognize other environmental testing techniques which meet or exceed the standards prescribed in DO-147 and referenced in this section. In this regard, it should be noted that § 37.9 permits a manufacturer to deviate, upon application and approval, from any performance standard prescribed by a TSO. Therefore, it is unnecessary to incorporate this commentator's recommendation in paragraph (d).

Section 37.200(f)(1). Several commentators recommended that the marking requirements proposed in this subparagraph be deleted, and the operator of the airplane merely be required to post battery replacement schedules in the airplane logbook. It was contended that some emergency locator transmitters are externally mounted thus resulting in exposure to the elements causing markings to fade. In addition, these commentators stated that because many transmitters are mounted internally in inaccessible places, checking would be difficult, and the tendency of many operators would be to neglect the battery replacement requirement.

The FAA anticipates no difficulty with this requirement. Most emergency locator transmitters will be internally mounted and visible. In the case of externally mounted transmitters, markings can be designed to remain legible even when exposed to the weather. Those transmitters that are not visible will be examined during normal airplane maintenance.

Two commentators recommended that nickel-cadmium rechargeable batteries and water-activated batteries be excepted from the requirements of subparagraph (f)(1) because, with regard to the former, they have an indefinite shelf life, and with regard to the latter, their condition is not time-related.

The FAA agrees that water-activated batteries have, for all practical purposes, an unlimited shelf life. Furthermore, it appears that this requirement should be qualified to take into account rechargeable batteries. Accordingly, § 37.200(f)(1) has been revised to except emergency locator transmitters with water-activated batteries from the battery-replacement-date marking requirement. In addition, § 37.200(f)(1) now permits those emergency locator transmitters using rechargeable batteries to be marked with a "recharging" date rather than a "replacement" date. This revision has necessitated a change in proposed § 37.200(g)(2), which will be discussed in connection with that section.

Section 37.200(f)(2). One commentator recommended that this subparagraph be revised to indicate that it does not apply to components that are mechanically connected to the main emergency locator transmitter unit, because, the commentator contended, there is no reason to identify such components. The FAA does not agree. The language used in this subparagraph regarding the marking of separate components has been used in several TSO standards without difficulty, and the agency considers it adequate for the purpose of requiring manufacturers to permanently set forth certain basic information

Section 37.200(g)(2). With regard to the battery useful life requirement of this subparagraph, one commentator recommended that the useful life be established by the battery manufacturer rather than the transmitter manufacturer, for the reason that the former is best qualified to provide data on the useful life of his product.

Section 37.200 is addressed to emergency locator transmitter manufacturers, and not to battery manufacturers and the FAA does not consider it practicable to divide TSO authorization between the two. Finally, the transmitter manufacturer can be expected to be adequately familiar with the useful life of the battery he is using.

As mentioned previously, it has been necessary to make certain minor revisions to accommodate rechargeable batteries. Accordingly, this proposed subparagraph has been revised to recognize rechargeable batteries by basing their useful life on the life of the charge.

Section 37.200(g)(5). One commentator contended that the language of this requirement concerning data relating to actual equipment performance could be interpreted to require testing to destruction, particularly with respect to shock, vibration, and high temperature. The FAA agrees that testing to destruction should not be required solely to obtain data for the equipment data sheet. Accordingly, proposed §37.200(g)(5) has been revised to require data sheets specifying the equipment's typical actual performance. The intent of this provision, as well as § 37.200(h) which refers to it, is to require that the equipment data sheet contain actual performance data for equipment of that type, not for each individual unit. As such, the manufacturer is permitted to determine what the performance characteristics are for his particular type of equipment, without being required to test each unit, or to test them to destruction.

Section 37.200(h). One commentator recommended that the provision requiring the transmitter manufacturer to furnish a copy of the installation instructions, and of the data sheet, with each unit be revised to except transmitters furnished in bulk to aircraft manufacturers or aircraft fleet operators. It was argued that this requirement is appropriate only for transmitters that are sold individually.

The FAA disagrees. If bulk transmitter deliveries were excepted from this requirement there would be no assurance that the ultimate user would get a copy of the data sheet required in § 37.200(g)(5). The bulk purchaser could resell the transmitter in small lots or individually.

Section 91.52(a). One commentator recommended that the requirement for an emergency locator transmitter be extended to the more than 4,000 rotorcraft now in service. This comment is beyond the scope of Notice 71-7; however, it should be noted that the FAA is currently examining this area to determine if further rule making is warranted.

With regard to the compliance date requirements of subparagraph (a)(2), two commentators stated that the three-year time table prescribed in Public Law 91-596 should be applied to operations conducted under Part 135, rather than the one year proposed in the Notice. It was contended that this time was necessary in order to adequately provide for the design of transmitter installations, particularly the antenna installation.

The FAA agrees that the effective date should be the same for all operations covered by § 91.52(a)(2), and that provision has been revised accordingly.

Section 91.52(b). Several commentators recommended that the words "a personnel type or" be deleted from subparagraph (b)(4) because such transmitters, it was contended, do not meet the intent of Public Law 91–596 since they require manual erection of the antenna and may fail to operate below 0° C. Furthermore, it was argued that in order to ensure that transmissions are omnidirectional with maximum signal strength, the antenna must be in place and operable in the event of a crash.

The FAA does not agree that use of the personnel type emergency locator transmitter should be prohibited for operations other than those conducted under Parts 121, 123, or 135. Standards for many classes of general aviation equipment, although providing an adequate level of safety, are generally less stringent than those applicable to equipment required for air carriers and commercial operators.

One commentator recommended that only non-automatic personnel type emergency locator transmitters be required, arguing that if the airplane were totally destroyed the transmitter would be also. The commentator described several crash configurations and stated that in those situations where the airplane was not destroyed, the normal airplane communication system or the non-automatic personnel type transmitter would prove to be the most effective emergency devices. It was the feeling of this commentator that the personnel type is more adaptable to more given situations.

The FAA does not agree that the personnel type emergency locator transmitter, whether automatic or non-automatic, should be specified for all operations. If the airplane suffers even minor damage, the electrical system of the airplane might be rendered inoperative, and thus normal communications equipment would be of no value. Even if left intact, use of the electrical system could be dangerous due to the possibility of a fuel leak. In addition, many airplanes are not even equipped with normal communications equipment.

The FAA is aware that externally-mounted transmitter antennas may be damaged in some crash situations, as pointed out by this commentator; however, the probability that they will remain intact, or at least functional, is good.

Another commentator recommended that the requirement that the transmitter be attached to the airplane, appearing in subparagraphs (b)(1)–(4), be deleted. It was argued that in the case of fleet operators who operate only a fraction of their fleet at any given time, this requirement would be unnecessary and burdensome.

In this regard, it should be noted that § 91.52 prohibits the operation of airplanes without an emergency locator transmitter attached. Consequently, the transmitter is not required to be attached when the airplane is in the hangar or parked on the ramp. Therefore, the operator need not attach the transmitter to the airplane until it begins its taxi run preparatory to flight. This will permit the operator to use several transmitters for his entire fleet.

Finally, one commentator recommended use of the word "installed" rather than "attached" because that was the word used in Public Law 91–596 and because it is more definitive. The FAA selected the term "attached to" rather than "installed on" to ensure that the emergency locator transmitter is subjected to crash-inertia forces and is thereby automatically activated. The term "installed on" could be erroneously interpreted to permit the operator to carry the transmitter on his person, or on the seat next to him, where it might not be subjected to the full inertia force in a crash.

Section 91.52(c). Three commentators recommended revision of this proposal to require that personnel type and automatic portable type emergency locator transmitters, also be mounted as far aft as practicable because reliability would be compromised if installed in a non-aft location. Furthermore, it was contended that aft mounting is required by the statute, and no justification exists for excepting any type of transmitter from the requirement.

The FAA considers ready accessibility to be an important safety consideration with regard to personnel type and automatic portable type emergency locator transmitters, and thus, a forward location is permitted for them.

One commentator recommended that the FAA require emergency locator transmitters to be installed "in a manner that complies with the applicable shock requirements of § 37.200(b)." The commentator contended that the proposed language "minimize the probability of damage" was vague, whereas the various RTCA documents referenced in § 37.200(b) specify a suitable criterion for shock resistance.

This requirement is objective, covering many different kinds of attachment methods in various airplanes. On the other hand, § 37.200(b) applies only to the emergency locator transmitter itself and is not related to methods of attachment. This type of requirement is useful in this situation because it permits the exercise of engineering judgment in the field. The proposed language appears elsewhere in the Federal Aviation Regulations and has caused no problems in the past, nor do we anticipate any now.

Section 91.52(d). Several commentators recommended that the "50 percent of useful life" battery replacement criterion be deleted in favor of a requirement that the battery be replaced "at least during each annual inspection." Another commentator suggested that the battery be replaced "every year or at such shorter intervals as is determined by the battery manufacturer's guaranteed useful life." These commentators contended that exposure to prolonged high temperature (as when the airplane is parked in the sun) causes rapid deterioration of the battery, which may render the emergency locator transmitter inoperative before the 50 percent shelf life date is reached.

The FAA does not agree that the alternatives suggested would serve the purpose more effectively than the agency's "half-life" proposal which takes into account probable exposure to temperature extremes and typical decrease in battery capacity when the transmitter is not in use. However, it has been necessary to make a minor revision to conform with previously discussed changes to § 37.200(f)(2) and § 37.200(g)(2) with regard to rechargeable batteries.

Section 91.52(e). One commentator recommended that the proposals in this paragraph to permit the ferrying of airplanes for the purpose of installing or repairing a transmitter, be deleted and replaced with a 30-day grace period. It was argued that under the proposal, operators in remote areas would have to ground their airplanes for long periods while awaiting repair of emergency locator transmitter.

The FAA does not agree that the suggested 30-day grace period is necessary. As is the case with other required equipment, ferry privileges are available for those operators affected by these requirements. In addition, it is expected that relatively few aircraft will be affected by the December 30, 1971, compliance date, and for those that must be equipped by the December 30, 1973, compliance date, we expect service facilities for emergency locator transmitters to be widely available by that time.

Section 91.52(f). Several commentators recommended that proposed paragraph (f) of § 91.52 excepting training flights conducted within a 20-mile radius of base be deleted, stating that once airborne an airplane not equipped with a transmitter, pursuant to this exception, could go beyond the 20-mile limit. Furthermore, it was contended that often the area within such a radius could be such that location of a downed aircraft would be difficult without the emergency locator transmitter. Finally, these commentators expressed concern that the exception could be used as a loophole by those who wish to operate without the transmitter.

The FAA recognizes that this exception (which is expressly prescribed in new Section 601(d)(2) of the Federal Aviation Act of 1958) may present some administrative difficulty, but will defer regulatory action thereon until service experience indicates what, if any, problems may arise.

One commentator recommended that all air carrier aircraft be required to carry an emergency locator transmitter, contending that despite radar surveillance, a number of downed air carrier aircraft were not quickly located.

Except in the case of air taxi and charter airplanes, the FAA does not believe that an emergency locator transmitter requirement can be justified at this time for all airplanes used in air transportation. These airplanes, operated under Part 121, are routinely flown under the operational control of the air carrier by means of flight following procedures, and the large majority of these flights are conducted in accordance with flight plans, along established routes, and into airports that are near high density population areas. In addition, most of these airplanes are equipped with ATC transponders which can be used to signal in an emergency.

Section 91.52(g). The proposals in this paragraph received numerous comments which, generally speaking, recommended that the FAA allow the continued use of emergency locator transmitters approved under existing TSO–C61a. The following "grandfather clause" recommendations were made: permit the use of transmitters approved under TSO–C61a before the effective date of this amendment; permit the use of those so approved and purchased before the effective date of this amendment; and permit the use of transmitters approved by the State of California. In addition, one commentator suggested a cutoff date for the sale of transmitters that do not meet the proposed standards. In support of these recommendations, the commentators made the following arguments: several thousand general aviation aircraft are currently equipped with transmitters approved under TSO–C61a, and the operators of these aircraft relied on the assumption that they were in compliance with an acceptable FAA standard. As such, these persons are entitled to a reasonable transition period in which to comply with the new standards. Furthermore, there is no basis for wholesale condemnation of currently used emergency locator transmitters, even where they are deficient in some respects. In fact, some exceed the requirements in TSO–C61a and approach the proposed standards in all essential respects.

The FAA recognizes the need for an adequate transition period and agrees that appropriate relief is warranted. Accordingly, proposed § 91.52(g) has been revised to permit, until December 30, 1975, the use of an emergency locator transmitter that does not meet the requirements of § 91.52, provided that the transmitter: has been installed and approved before the effective date of this amendment; has been manufactured under a TSO Authorization issued against TSO–C61a; transmits simultaneously on 121.5 and 243.0 MHz; and after the applicable effective date, prescribed in § 91.52(a), is attached to the airplane.

Section 121.339(a)(4) and 121.353(b). Comments similar to those dealt with in the preceding discussion were received with regard to the proposed requirements of Part 121 concerning survival type emergency locator transmitters. These comments pointed out that U.S. air carriers have just recently completed installation of survival type emergency locator transmitters to meet ICAO standards, and thus have entire fleets with new equipment which complies with TSO–C61a, and to require them to now switch over to the new equipment, would be unreasonably burdensome. Furthermore, it was contended that in many cases, currently installed equipment meets, for the most part, the proposed standards of Notice 71–7.

Again, the FAA agrees that relief is justified in this situation and safety will not be adversely affected by permitting certain "grandfather" rights. Accordingly, proposed §§ 121.339(a)(4) and 121.353(b) have been revised to permit, until December 30, 1975, the use of a survival type emergency locator transmitter that does not meet the applicable requirements of § 37.200, provided that that transmitter: has been installed and approved before the effective date of this amendment; has been manufactured under a TSO Authorization issued against TSO–C61a; and transmits simultaneously on 121.5 and 243.0 MHz.

In addition, several commentators made suggestions similar to those discussed previously concerning battery replacement criteria. Accordingly, appropriate changes have been made to these requirements to accommodate rechargeable batteries.

Finally, comments discussing the number of survival type emergency locator transmitters required have been dealt with previously in the discussion of §§ 25.1415 and 29.1415. No further mention is necessary here.

Section 135.163. Again, several comments were addressed to the number of survival type emergency locator transmitters that should be required on an airplane. The discussion of these comments in connection with §§ 25.1415 and 29.1415 is sufficient for the purposes of this section as well.

With regard to battery replacement criteria, the necessary change to accommodate rechargeable batteries has been made in this section.

Finally, the "grandfather" rights discussed previously have been adopted for this section as well.

Interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, Parts 25, 29, 37, 91, 121, and 135 of the Federal Aviation Regulations are amended, effective October 21, 1971.

These amendments are made under the authority of sections 313(a), 601, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1424), and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25–30

Position Light System Dihedral Angles

Adopted: October 28, 1971 **Effective: November 5, 1971**

(Published in 36 F.R. 21278, November 5, 1971)

The purpose of these amendments to §§ 23.1387, 25.1387, 27.1387, and 29.1387 of the Federal Aviation Regulations is to permit the installation of rear position lights with minor obstructions in the field of coverage.

Sections 23.1387, 25.1387, 27.1387, and 29.1387 presently require, in part, that the rear position light show unbroken light within a dihedral angle formed by two intersecting vertical planes making angles of 70° to the right and left, respectively, of a vertical plane passing through the longitudinal axis. Other related provisions of the regulations require that the rear position light be mounted as far aft as practicable.

In certain aircraft designs incorporating swept vertical tail surfaces, the obstructed visibility requirements may be met only by locating the rear position light on the trailing edge of the rudder. Because this location may cause a number of problems, including complex electrical installation and adverse rudder flutter characteristics, some manufacturers consider the aftmost tip of the fuselage to be a more suitable location. Thus, while the rudder position may be farther aft, the fuselage location is as far aft as is practicable. At the same time, however, the fuselage location does not comply with the obstructed visibility requirements where parts of the rudder and vertical stabilizer of a swept tail project into space required to be unobstructed.

For aircraft having this problem, the obstruction resulting from use of the aft fuselage location would, nevertheless, be relatively small because of the thinness of the vertical stabilizer and rudder. Moreover, the obstruction occurs at a high angle above the longitudinal axis of the aircraft so that except for the near-zenith position, the rear position light shows unbroken light.

Related requirements for position lights allow diminishing light intensity with increasing angle above or below the horizontal. Thus, for angles 40° and more above and below the horizontal plane, the position light intensity need be only 5 percent of the light intensity in the horizontal plane. This provision thus recognizes that the significance of a position light decreases as zenith is approached.

A provision similar to that being here established for the rear position light already exists with respect to the anticollision light. In this connection, minor visibility obstructions permitted in the rearward direction in the field of coverage of the anticollision light have been determined not to be detrimental to safety.

In light of the foregoing, obstructions within the dihedral angle in which the rear position light must show, which do not exceed 0.04 steradians in coverage and which occur within 30° of a vertical line through the rear position light, would not adversely affect safety. In addition, these amendments permitting minor obstructions in the field of coverage of rear position lights are consistent with the provisions of §§ 23.1385(c), 25.1385(c), 27.1385(c), and 29.1385(c) which recognize practicable considerations in the location of rear position lights.

For the foregoing reasons and since these amendments relieve a restriction and impose no additional burden on any person, I find that notice and public procedure thereon are unnecessary and that good cause exists for making them effective on less than 30 days notice.

In consideration of the foregoing, Parts 23, 25, 27, and 29 of the Federal Aviation Regulations are amended as follows, effective November 5, 1971.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-31

Flight Recorders

Adopted: December 3, 1971 **Effective: January 10, 1972**

(Published in 36 F.R. 23548, December 10, 1971)

This amendment to Part 25 of the Federal Aviation Regulations changes § 25.1459 (a)(1) to reflect the effect of Amendment 25-23 on that section, and removes an inconsistency resulting from that amendment.

Amendment 25-23 (effective May 8, 1970, published in the Federal Register on April 8, 1970, 35 F.R. 5665) amended § 25.1333 to permit, under certain specified conditions, the connection of additional instruments, systems, or equipment, not prescribed in § 25.1303(b), to the operating systems for the required instruments. One such additional piece of equipment is the flight recorder which is governed by § 25.1459, and which, prior to May 8, 1970, could not be connected to the operating system provided for the first pilot's flight instruments, other than to the air data computer. However, Amendment 25-23 inadvertently failed to amend § 25.1459(a)(1) to make it consistent with the changes to § 25.1333. Therefore, § 25.1459(a)(1) is being amended consistent with Amendment 25-23 by deleting the requirements pertaining to the source of the airspeed and altitude data except the requirement that the data must be obtained from sources that meet the accuracy requirements of §§ 25.1323, 25.1325, and 25.1327, as appropriate.

Since this amendment merely corrects a provision of the regulations and imposes no additional burdens on regulated persons, I find that public notice and procedure thereon are unnecessary.

In consideration of the foregoing, § 25.1459(a)(1) of the Federal Aviation Regulations is amended, effective January 10, 1972.

This amendment is made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25–32

Crashworthiness and Passenger Evacuation Standards: Transport Category Airplanes

Adopted: February 15, 1972 **Effective: May 1, 1972**

(Published in 37 F.R. 3964, February 24, 1972)

The purpose of these amendments is to improve the crashworthiness and the emergency evacuation equipment requirements and operating procedures for transport category airplanes.

These amendments are based on a Notice of Proposed Rule Making (34 F.R. 13036, August 12, 1969) circulated as Notice 69–33, dated August 6, 1969.

Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented in the numerous comments received in response to Notice 69–33. Based upon those comments and upon further review within the FAA, a number of substantive and editorial changes have been made to the proposed rules. However, in view of the number of comments received only the most pertinent ones are discussed hereinafter. Except as modified by the following discussion, the reasons for the amendments are those contained in the Notice.

PART 25

In Notice 69–33 it was proposed to make certain of the requirements applicable to airplanes for which applications for type certificates have been filed, but the type certificates would not be issued until after the effective date of the proposed amendments. Several comments were received objecting to this proposal because the requirements need to be considered in the initial design stages of an airplane, which is several years prior to the issuance of the type certificate, and to impose them on airplanes nearing type certification might require a substantial redesign of the airplane and would necessitate production-line type design changes thereby dislocating production. Commentators point out that any safety benefit that might result from complying with the proposed requirement would not be commensurate with the unreasonably heavy penalty at this late stage in the certification process. In addition, several comments contended that a number of the proposed requirements are inappropriate and others are unnecessarily severe for airplanes that have a low passenger seating capacity. The FAA's purpose in proposing to make the requirements retroactive was to assure that the new generation of large jumbo jets for which applications for type certificates had been filed, would meet crashworthiness and passenger evacuation requirements that were consistent with the state-of-the-art. However, the type certification basis of those airplanes have now been established and the proposed requirements were considered in determining the airworthiness standards applicable to those airplanes. Therefore, it is no longer necessary to make the proposed requirements retroactive for these airplanes. Furthermore, the proposed retroactive requirements were not developed with the smaller transport category airplanes in mind. The crashworthiness and passenger evacuation problems increase as the size and passenger capacity of the airplane increases. Most of the proposed requirements are related to the design requirements of the larger transport category airplanes and the need to provide rapid egress for a large number of passengers in an emergency with minimum confusion. Any attainable safety benefit that might result by applying the proposed requirements retroactively to the smaller transport category airplanes that have low seating capacities, smaller cabin areas, and less complex designs would not be commensurate with the heavy burden that such a retroactive requirement would impose. Accordingly, proposed § 25.3 and the proposed amendment to § 21.17 have been withdrawn, and the proposed retroactive requirements of §§ 121.310 and 121.312 have been deleted. In addition, the "September 30, 1969" dates specified in present § 121.310(a) and (h) have been editorially revised for consistency with the dates specified in this amendment. No substantive change has been made in the present requirement by this date change since the Part 25 requirements referenced in these sections have remained unchanged from September 30, 1969 to the date of this amendment.

In addition, the FAA has determined that certain of the requirements in proposed §§ 25.562, 25.721, 25.787, 25.807, and 25.812 are inappropriate and unnecessary, or are unnecessarily severe, for transport category airplanes that have maximum passenger seating configurations, excluding pilot seats, of nine seats or less. In those instances, the proposed requirements have been revised to provide exceptions and to include requirements for such airplanes that provide a level of safety for such airplanes equivalent to that for airplanes with larger passenger seating configurations. Insofar as the requirements are stated in terms of airplane passenger seating "configuration" whereas the present rules refer to passenger "capacity" no substantive change has been made by these revisions and none is intended. It should be noted that the foregoing classification is consistent with Amendment 23-10, adopted subsequent to the issuance of Notice 69-33, which limited the applicability of Part 23 to small airplanes that have a passenger seating configuration, excluding pilots seats, of nine seats or less.

Several comments objected to the proposed amendment of § 25.561 increasing the ultimate inertia forces in the upward and sideward direction and adding an aft load requirement. The commentators contended that the proposed changes to the present requirement are unnecessary, that the proposed side load and upward load factors are not realistic, that the aft load criterion is not appropriate, and that the costs associated with the increase in airplane weight that would result from compliance with the proposed amendment imposes an unreasonable burden. In view of the comments received, the FAA believes that further study of this proposal is necessary. Therefore, the proposal and the related change in proposed § 121.310(f)(6) have been withdrawn for further study and consideration in subsequent rulemaking.

In Notice 69-33 it was proposed to add a new § 25.562 containing various requirements dealing with fuel containment. There were a number of comments indicating that the proposal was too severe and too detailed. It was also pointed out that the proposal implies a structural design requirement for a condition well beyond initial structural failure and for which technical analysis would not be reliable. There was also an indication that the reference to injury to occupants is inappropriate in connection with a proposal dealing with design requirements for fuel containment. Finally, it was pointed out that there is no practical was to ensure, with absolute certainty, that an airplane would comply with this proposal in a wheels-up landing. The FAA agrees with these comments and the proposed new § 25.562 has been withdrawn. Instead, the substance of paragraph (a) of proposed § 25.562 has been added as paragraph (b) of § 25.721 taking into account the comments noted above.

Subsequent to the issuance of Notice 69-33, § 25.721 was substantially amended and proposed paragraph (d) is now paragraph (a). Moreover, in response to a comment, the parenthetical expression in the proposed amendment has been changed to make it clear that the regulation is based on the assumption that the overloads act in the upward and aft directions.

Concerning the proposed amendment to § 25.787, several commentators recommended that the proposal be changed to require restraints for each stowage compartment in the passenger cabin rather than requiring that such compartments be completely enclosed. The FAA does not agree. The intent of the proposal is to provide more protection than that provided by restraint devices, such as tie-down straps or webbing. The conventional webbing, nets, or tie-down straps are effective provided that someone makes the necessary connections and adjustments.

Several comments stated that the term "item of mass" in proposed § 25.789 should be defined. One commentator indicated that § 25.789 should be made applicable only to galley equipment, service carts, and crew baggage. The FAA does not agree. A complete enumeration of all the possible items of mass that could be in a passenger or crew compartment would not be practicable. Part 25 contains the type certification requirements for transport category airplanes and § 25.789 is applicable only to items of mass that are included in the type design of the airplane. Section 25.789 is intended to provide protection from each such "item of mass" located in the passenger or crew compartments, such as galley equipment, fire extinguishers and other safety equipment, and the proposal has been revised to clearly state the requirement.

In response to comments received, § 25.791 has been revised to make it clear that only one sign notifying when smoking is prohibited and one sign notifying when safety belts should be fastened must, when illuminated, be legible to each person seated in the passenger cabin under all probable conditions of cabin illumination. In addition, consistent with past practice, the proposal has been revised to make it clear that signs may use either letters or symbols, and that the standards apply only when passenger information signs are installed to comply with applicable operating rules.

The FAA received several recommendations with respect to § 25.803. In this connection, it was recommended that only "initial" reflectance and "initial" contrast should be specified for the escape route as they are the only ones under the manufacturer's control. The FAA does not agree. Reflectance and contrast do not inherently deteriorate, as do radioactive signs, and if the markings are chipped or scuffed, they can be restored to their original level by ordinary maintenance. The FAA does not agree with one commentator that the requirement for a minimum width for the escape route in § 25.803(e) should be deleted. Without a minimum requirement, the escape route could be defined by a strip so narrow that it would not provide proper identification of the escape route and would tend to slow down the flow of passengers evacuating the airplane. However, the proposed requirement has been revised to specify an escape route width of 42 inches at Type A exits since this is the minimum width permitted for those exits. In addition, the proposal has been revised in response to several comments to specify an escape route width, a reflectance, and a surface-to-marking contrast requirement for those escape routes only that do not have a means, such as side rails or guards, for channeling the flow of evacuees. Such channel devices must be designed to accommodate the needs of the particular exit and escape route and provide a rapid and effective means for passenger evacuation.

Several comments were received concerning the proposed change to the requirements for a Type III exit stating that it would be difficult for the average persons to exit through a 20 x 36 exit (when this exit is not over the wing) with a step up of 20 inches from the cabin floor and enter an inflatable slide. It was recommended that the present definition of a Type III exit be retained. The FAA does not believe that the Type III exit need be restricted to overwing locations. A Type III exit with a 20-inch step up to a slide should not present any more difficulty to the average person than a Type III exit located over-the-wing having a 20-inch step up inside the airplane and a 27-inch step down outside the airplane to the wing. It should be noted that one of the considerations in permitting Type III exits to be used in other than over-the-wing locations is the fact that over-the-wing exits may not be the most desirable exits in a ditching situation. Damage assessment of airplanes in ditchings shows that the wing flaps may be severely damaged and both the leading and trailing edge of the wings may have torn-metal projections. These may damage life rafts launched and loaded from the wing. In such circumstances, it would be preferrable to launch and load rafts from non-overwing locations.

Several comments recommended that the Type IV exit be retained for the smaller transport category airplanes, particularly those having a low passenger seating capacity, on the ground that the installation of Type III exits instead of Type IV exits would significantly increase the structural weight of the airplane, and that this weight penalty is an unreasonable burden inasmuch as any benefit that might be afforded by a Type III exit would have little effect on airplane evacuation. The FAA agrees with the comments to the extent that they apply to small transport category airplanes that have a passenger seating configuration, excluding pilot seats, of nine seats or less. Accordingly, the present definition of a Type IV exit has been retained in § 25.807(a), and proposed § 25.807(c)(1) has been revised to permit the use of Type IV exits (one on each side of the fuselage) on such airplanes. In addition, the provisions of present § 25.807(c)(7) and (d) and § 25.813 that pertain to Type IV exits have been retained.

Several comments were received recommending that other provisions of current § 25.807(c) also be changed. One comment recommended the deletion of the requirement that where more than one floor level exit per side is prescribed, at least one such exit must be located near each end of the cabin. In another instance, it was recommended that applicants should be able to select the values in either the table in paragraph (c)(1) or (c)(2). The FAA does not agree with either of these suggestions. The change to § 25.807(c) proposed in Notice 69-33 concerned only the deletion of the reference to, and the values for, Type IV exits. Both of the foregoing recommendations are outside the scope of the Notice. Finally, a request was made to change the values for a Type A exit from 100 passenger seats to 115 passenger seats. The FAA does not agree. There has not been sufficient service experience with the Type A exit to date to justify the requested change. While the request may have merit, it will require further study by the FAA.

Several comments noted that the requirements of present § 25.809(b) do not include consideration of fuselage deformation, which is covered in other rules, and that it should be made clear that the proposed addition to the present rule does not include consideration of such deformation. The FAA agrees and the proposed amendment to § 25.809(b) has been revised to clearly state the intent of the requirement. In addition, proposed subparagraph (b)(1) has been revised to make it clear that the requirement applies to the airplane when it is in the normal ground attitude as well as in the attitudes corresponding to the collapse of one or more legs of the landing gear.

A comment was also received recommending that proposed § 25.809(b)(2) and (f)(1)(ii) be changed to require the total time from exit actuation to full side deployment to be not more than 10 seconds. This suggestion is beyond the scope of the Notice and requires further study. The FAA intends to consider it in connection with future rulemaking. However, § 25.809(f)(1)(i) has been revised to clearly state that deployment must begin during the exit opening cycle.

In response to a comment, proposed paragraph (g) of § 25.809 has been revised to allow the showing required by that paragraph to be made by tests alone or by a combination of analysis and tests.

One comment recommended that the requirement in § 25.809(h) be revised to prescribe that means must be provided to assist evacuees to reach the ground from overwing exits if the place on the airplane structure at which the escape route terminates is more than 6 feet above the ground with the airplane on the ground and the critical landing gear collapsed. Under the current requirement the 6 feet is measured with the airplane on the ground and all landing gear extended. The FAA intends to consider this recommendation, which is beyond the scope of the Notice, in subsequent rulemaking.

Comments received concerning proposed § 25.809(i) indicated that the objective of this proposal had been misunderstood. The intent of the proposal is to prevent the installation of a powered exit system, the failure of which would render more than one exit totally inoperative. If a single power-boost or single power-operated exit-opening system is the primary system for operating more than one exit in an emergency, each exit must be capable of meeting the requirements of § 25.809(b)(1) in the event of failure of the primary system. The proposed requirement has been revised to make this clear.

A comment was received recommending that the exit locator signs required in § 25.811(d) not be required in airplanes having a seating capacity of 21 or less if the exit marking sign is plainly visible from any point in the cabin. The comment stated that this should be done because under the proposal the overhead locator signs would be within a few feet of the exit marking signs. The purpose of the exit locator sign is to aid in locating emergency exits and it is anticipated that regardless of the size of an airplane or its seating capacity, the exit locator signs will be near the emergency exit. This is the intent of the regulation. Another comment recommended that the proposal should require that the exit locator sign indicating the location of the nearest exit must be visible to each seated passenger. The FAA has found that these signs provide for effective evacuation performance. The primary need to see exit locating signs occurs when the passenger reaches the aisle during emergency evacuation. As a practical matter, in existing airplanes, the exit locating signs are generally visible to passengers in their seats.

A comment recommended that instead of requiring the operating handle for Type III exits to be self-illuminated, the rule should permit lighting from the emergency lighting system as an acceptable alternative. The FAA does not agree. Adequate illumination of Type III emergency exit operating handles in an emergency situation can only be provided through self-illumination. Persons crowding the exit are likely to block off light from any source other than from the handle itself. It was also recommended that the operating instructions for opening emergency exits should be readable from the aisle rather than a distance of 30 inches. The FAA disagrees. The instructions need only be readable by the persons at or near the exit who are in a position to open the exit. The 30-inch requirement has been in the regulation for many years and there is no evidence that it is not adequate. However, since paragraph (e) of § 25.811 applies only to operation of an exit from the inside, it has been revised to make this clear. It was also recommended that self-illuminated handles be required on all passenger emergency exits instead of limiting them to Type III exits. All Type A and Type I exits and all Type II exits not located overwing, are floor level exits and the rules now require general illumination for passageways leading to such exits. This general illumination provides adequate illumination for operating handles and instructions. However, the comment may have merit with respect to Type II and Type IV overwing exits and the FAA plans to consider it in subsequent rule-making action with respect to such exits.

It was also recommended that each sign use the words "emergency exit" to eliminate the possibility that passengers might attempt to open emergency exits in other than emergency conditions. The FAA does not consider that such a change is necessary. All exits are "emergency" exits and the FAA considers that the word "exit" is more appropriate.

In response to comments received, proposed paragraph (a) of § 25.812 has been revised for the purpose of clarifying the requirement. No substantive change has been made by this revision.

One commentator stated that proposed § 25.812(b) should be revised to require a supplementary self-illuminated sign that would remain lighted at all times to make passengers aware of the exit location. The FAA does not consider that such a requirement is necessary. The purpose of the proposal is to make passengers aware of the location of the exits during the confusion attending an emergency. The FAA does not consider that passenger locating signs need be illuminated during normal operation; the general cabin lighting system normally provides sufficient illumination for the unlighted locator signs.

In response to a comment, the proposed requirements of § 25.812(b)(1) have been revised to provide some tolerance in the letter height to stroke-width ratio for emergency exit locator signs. The final rule allows a letter height to stroke-width ratio of not more than 7:1 nor less than 6:1.

One comment objected to the requirement in § 25.812(d) that the floor of the passageway leading to each floor-level passenger emergency exit must be provided with illumination that is not less than 0.02 foot-candle. The commentator stated that 0.01 foot-candle is all that is necessary in evacuation systems, and that, because eye adaption is more difficult at higher illumination levels, 0.02 foot-candles might be detrimental. The FAA considers the illumination of the passageway leading to an emergency exit to be very important and critical to safety. Evacuees must have assurance of adequate illumination for rapid and uninterrupted movement to the exit as well as for movement through the exit. While the FAA is aware of the lighting preadaption problem, it nevertheless considers that 0.02 foot-candle illumination is essential for passageway lighting.

Subsequent to the issuance of Notice 69-33, the lead-in sentences of § 25.812(e) and (g)(2) were amended by Amendment 25-28, and the proposed changes to these paragraphs have been revised to include the later amendments, as revised for consistency with the requirements being adopted by this amendment.

One comment concerning the proposed requirement for a crew warning light in § 25.812(e)(2) indicated that a light burning continuously would result in power depletion. The flight crew warning light provides positive indication when the emergency lighting control device is neither armed nor turned on. The current drain is very small when related to the total electrical system demand and is outweighed by the gain in safety.

In response to a comment, the proposed requirement in § 25.812(f) that emergency lighting must be provided at each overwing exit for, among other things, a minimum width of 4 feet for a Type A exit has been changed to specify a minimum width of

42 inches. The minimum width of a Type A exit is 42 inches and the illuminated area need not be more than 42 inches wide.

One comment stated that the state-of-the-art permits each light to have its own independent power supply. The comment indicates that there is no reason to permit any light to be inoperative except those directly damaged by the fuselage separation and suggested that § 25.812(k) be changed accordingly. The FAA does not agree. This matter was considered in Amendment 25–15, adopted September 15, 1967. At that time, the FAA stated that it is not necessary to require that all lights except those directly damaged by the fuselage breakup remain operative after any single vertical separation of the fuselage during crash landing. The FAA considers that the present requirement which permits up to 25 percent of certain of the emergency lights, in addition to those directly damaged by the fuselage breakup, to be rendered inoperative is all that is required in the interest of safety. However, it should be noted that under current requirements certain important interior and exterior lights must still remain operative.

A recommendation was made to change the lead-in statement in § 25.853 to refer to "typical" decorative surfaces and to define such surfaces as "paint finishes and decorative textured laminates applied to the materials." The FAA does not believe that this change is necessary. Under this proposal repetitive testing would not be required for finishes and decorative surfaces that are found to be "typical", with respect to their burn characteristics, of finishes and decorative surfaces already tested.

In response to comments received, § 25.853(a) has been revised to make it clear that the requirement does not apply to compartments for the stowage of small items, such as maps and magazines. However, the FAA does not agree with the recommendation that synthetic materials should be tested by a method other than a vertical test. While it is recognized that the test procedures referenced in § 25.853 could be made more stringent in various ways, the FAA has no reason to believe that materials (whether synthetic or other) meeting the prescribed tests do not have adequate burn characteristics.

One commentator stated that test evidence suggests that a reduction in the flame resistant standards of sidewall materials up to the top of the window line can be made with no loss of overall safety compared with the standard above this height, having regard to the lesser tendency for flame to spread at the lower level. The FAA does not agree. While the FAA is aware of higher potential temperature and flame spread at the upper sidewalls and ceiling, it is also aware that wall panels and partitions normally are continuous to floor level. Furthermore, there is no certainty that the cabin ceiling and upper sidewalls will remain uppermost after a crash landing.

One comment concerning § 25.853 suggested that "covering of upholstery" be deleted from the requirements of paragraph (b). The FAA agrees. The term "upholstery" includes the material used to stuff and to permanently cover furniture. It was also suggested that cargo compartment liners, insulation blankets, and cargo covers be deleted from § 25.853 and that all cargo compartment requirements be placed in § 25.855. The FAA does not agree that this is necessary. However, the provisions have been revised to clearly set forth the distinction between the fire protection requirements of §§ 25.853 and 25.855. In this case, the final rule makes it clear that § 25.853 covers, in addition to other materials, materials used in convertible passenger/crew cargo compartments. On the other hand, § 25.855 covers cargo and baggage compartments not occupied by passenger or crew.

A number of comments suggested that certain of the items listed in proposed § 25.853(b) could be constructed with elastomeric materials and that the rule should not require this material to be listed to the standards of paragraph (b). The FAA agrees and the proposal has been revised to allow those items, if constructed of elastomeric materials, to be tested under the requirements of paragraph (b–2).

With respect to proposed § 25.853(c), there was a comment recommending that the words "instrument assemblies" be changed to read "instrument panels". The FAA does not agree. Under the current rules, "edge light instrument panels" made of specified materials were exempt from the requirements of paragraph (a) of § 25.853 applicable to all wall and ceiling panels. Notice 69–33 proposed to remove that exemption since there are materials that can be used in edge light instrument panels that are available and that meet the self-extinguishing requirements of paragraph (a). The proposed requirement concerning "edge lighted instrument assemblies" is not related to edge lighted instrument panels. The edge lighted instrument assembly requirement applies to one or more instruments situated in a common housing. Such assemblies may be installed in edge lighted instrument panels.

A comment was also received requesting that proposed § 25.853(d) be changed so that "small parts" need not be tested. The commentator contends that it is impractical to test each small part and that the chemistry of materials is sufficiently well known to prevent the use of rapid burning materials. The FAA does not agree that all small parts need not be tested. However, the requirement has been revised to provide that small parts which the Administrator finds would not contribute significantly to the propogation of a fire, need not be tested. Another comment stated that the 4 inch/min. burn rate is unnecessarily lenient for all small parts and recommended a 2.5 inch/min. burn rate. The FAA does not agree. The availability of materials that would meet the 2.5 inch/min. burn rate is limited. Moreover, the quantities of materials involved in this recommendation is not sufficient to warrant the more stringent burn capability.

Various comments also requested clarification regarding the applicability of proposed § 25.853(d) to motion picture film. The motion picture film that is used aboard aircraft now is safety film. In response to these comments and after further consideration, the FAA has determined that motion picture film need not meet the proposed requirements, but must meet the specifications for safety film set forth in Standard Specifications for Safety Photographic Film PHI.25. The proposal has been revised accordingly. Moreover, the ducts through which the motion picture film travels during operation in flight must meet the requirements of § 25.853(b) which apply to other ducts on the airplane.

The purpose of the proposed amendment to §§ 25.855 and 25.857 was to delete the requirement for a liner in cargo compartments from § 25.857 and put it in § 25.855. However, it appears that the proposed change to § 25.855, while establishing certain characteristics for liners, does not expressly require a liner. Therefore, proposed § 25.855(a) has been revised to require a liner in Class B through E cargo and baggage compartments. Moreover, it has been brought to the FAA's attention that the proposed amendment could be interpreted as prohibiting "a pinhole or translucent resin area through which light can be seen but flame does not penetrate." This was not intended and the appropriate change has been made to clarify the proposal.

In a comment on § 25.1359(d), it was recommended that this requirement should apply to electrical wire and cable insulation in a "pressurized zone" rather than in the entire fuselage. The FAA does not agree. With respect to wire and cable insulation, the FAA is equally concerned about all areas of the fuselage. Burning wire insulation could cause the spread of a fire from a nonpressurized zone to a pressurized zone. Another comment recommended that wire insulation must be self-extinguishing when tested at an angle of 60°, that a burn length requirement not to exceed three inches should be added, and that the dripping requirement should be changed to an average of three seconds. It was also recommended that the proposal should refer to "coaxial cable" rather than "cable" and should specify a burn rate of 2.5 inch/min. for that cable. The test procedure specified in Appendix F for wire and cable is a 60° test. Therefore, it is appropriate to refer to the 60° test in § 25.1359(d). Moreover, through oversight, the proposal did not contain a burn length requirement which is essential in determining that any material is self-extinguishing. Therefore, the proposal has been changed to specify a three-inch burn length. However, the FAA does not agree that the proposal should be changed to refer to coaxial cables and to specify a 2.5 inch/min. burn rate. The FAA considers that all electrical cable insulation must meet the proposed fire protection requirement, including coaxial. Since the regulation now contains a burn length requirement as the criterion for self-extinguishing properties, there is no need for a burn rate requirement.

A comment recommended that the proposal be revised to require a single wire vertical test with a 2-second extinguishing time and a 10-wire bundle test with a 5-second extinguishing time. The FAA does not believe that these tests are necessary to ensure that electrical wire and cable insulations have adequate self-extinguishing characteristics. The proposed requirement covers both burn length and extinguishing time and also permits persons to use any approved equivalent method for determining that the insulation is self-extinguishing. The test methods recommended could be used if they are equivalent to the method stated in the Appendix.

In response to a comment, paragraph (a) of Appendix F has been changed to add a limitation of 24 hours as an alternative to reaching moisture equilibrium. The FAA believes that this revision would not significantly affect the outcome of the tests. In addition, the proposed paragraph (b) has been revised to permit testing material of the actual size used in the airplane if it is smaller than the specified 2 inches wide and 12 inches long.

In response to comments, the Federal Standard referenced in paragraph (c) of Appendix F has been revised to reflect the correct designation and paragraph (f) has been revised to specify that the flame must contact the center of the material.

In response to comment, the proposal covering burn length has been revised to make it clear that the burn length excludes areas where material has melted away from the heat source. Finally, in response to comments a number of clarifying changes have been made to the proposal for the 60° test applicable to wire and cable. In this connection, the rule now requires the testing of a minimum of three specimens in place of the statistical determination. It also allows the upper end of the specimens to be passed over a rod or pulley and the use of a Tirrill burner as well as a Bunsen burner. The requirement for a ¼ inch inlet and the centigrade reference for the burner have been deleted for consistency with other test requirements.

PART 37

The proposed changes to §§ 37.132, 37.136, and 37.178 have been incorporated into the appropriate provisions under those TSO's to make it clear that the new requirements apply only to new models of equipment manufactured on or after the effective date of the new requirements.

PART 121

In Notice 69–33, it was proposed to amend § 121.215 to cover only the requirement for ash trays and to require placarding when smoking is not allowed. This amendment was proposed on the grounds that all the other fire protection requirements currently contained in § 121.215 concerning cabin interiors are now covered under other provisions in Part 121. While this statement is appropriate insofar as the later aircraft are concerned, it is not appropriate with respect to all of the older aircraft covered under Subpart J. Thus, until such time as there is a major overhaul of a cabin or a refurbishing of a cabin interior on those aircraft as provided in § 121.312, the fire protection requirements of § 121.215 are still necessary. The current provisions of § 121.215 have been retained with an appropriate reference to § 121.312.

It was also proposed to amend § 121.285 to require that cargo bins in passenger compartments meet the current requirements of § 25.853(b) upon adoption of these amendments. However, as indicated in one of the comments, such a proposed change would be inconsistent with current § 121.312 which only requires compliance with current § 25.853 for such cargo bins upon refurbishing or major overhaul of cabin compartment. The proposed change to § 121.285 has therefore been withdrawn.

While there was no change to § 121.291 proposed in Notice 69–33, the FAA is aware that some confusion exists concerning the application of § 121.291 to an airplane that is the same, from an emergency evacuation point of view, as another airplane in which the certificate holder has successfully demonstrated emergency evacuation. The FAA does not believe that in such a situation a repeat of the demonstration is necessary. Therefore, § 121.291 has been revised to make this clear.

While not covered in Notice 69–33 in any detail, the FAA considers it appropriate at this time to make certain editorial revisions to § 121.310. The many substantive changes being made to § 121.310 make these editorial changes desirable. In this connection all of the expired compliance dates in the section have been deleted and the various paragraphs have been appropriately rearranged to accommodate these deletions. No substantive changes have been made by these editorial revisions and none is intended. These editorial revisions affect paragraphs (a), (g), (h), (i), and (j).

A clarifying change has been made to § 121.310(a) to make it consistent with the corresponding requirement in § 25.812(a).

The proposed amendment to § 121.310(b)(2) has been revised to remove the inconsistency between the lead-in paragraph and the referenced provisions of § 25.812(b). The lead-in paragraph, as proposed in Notice 69-33, inadvertently retained the requirement that interior emergency exit marking and locator signs must have white letters one inch high on a red background two inches high. While this is appropriate for airplanes that are type certificated prior to the effective date of this amendment, it is inconsistent with the interior emergency exit marking requirements for airplanes that are type certificated after that date. In addition, the requirements set forth in subdivision (iii) of this proposal have been incorporated into subdivision (i) since they are not related to the new requirements set forth in subdivision (ii).

In answer to one commentator, a "transverse vertical separation" in § 121.310(d) is a vertical separation of the airplane that is approximately 90° to the longitudinal axis. The addition of the word "transverse" makes § 121.310(d) consistent with § 25.812(e)(3).

It was proposed to amend § 121.310(d) further by adding a new subparagraph (3) requiring a flight crew warning light. In response to a comment, and after further consideration, the FAA believes that it would be unreasonably burdensome to apply this requirement to airplanes already in service. However, airplanes newly certificated under § 25.812(e)(2) of this amendment will be equipped with a flight crew warning light, thereby providing an orderly transition to an improved level of safety.

The proposed amendment requiring that each exit emergency light provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing has been removed from subdivision (iii) of subparagraph (2) of § 121.310(d) and placed in a new subparagraph (3). It has been determined by the FAA that the operators will need additional time in order to make the modifications necessary to meet this requirement. Therefore, this new requirement has been placed in subparagraph (3) with a compliance date two years after the effective date of this amendment.

Several comments were received concerning proposed § 121.312. All of these comments cited difficulties with the requirement that cabin interior material must be replaced upon the first "major overhaul" or upon "refurbishing" of the cabin interior. The comments noted that cabin interiors are being maintained on an "on condition" basis and suggested that the rule should be so clarified. The incorporation of an "on condition" requirement in proposed § 121.312 would require a complete revision to that section and would be outside the scope of the Notice. However, it appears that a clarification of that regulation may be necessary and the FAA is currently studying this proposal with a view to initiating appropriate rulemaking.

Concerning the proposed change to § 121.317, it has come to the attention of the FAA that on some airplanes, the seat belt and no smoking signs are not visible to some seated passengers. In these instances, an announcement is made over the public address system that the signs have been turned on. In the final rule, operators of such airplanes have been given two years to procure and install the additional signs required to comply with the new rule. In the meantime, the operators must continue to meet the current requirements.

Section 121.391(d) has been revised to make it clear that: (1) this paragraph applies only to flight attendants required by § 121.391; and (2) the flight attendants need only be located at the required floor level exits. It was not intended that flight attendants be seated at the additional floor level exits because such exits do not, in general, meet all of the standards applicable to required emergency exits. The FAA believes that in the interest of safety, flight attendants must be located at the most effective floor level exits.

Several comments indicated that the requirement in § 121.571, that passengers be briefed to keep their safety belts "loosely and comfortably fastened while seated", would not be appropriate. After such a briefing, passengers might not have the belt fastened tight enough to provide the necessary restraint in the event of unexpected turbulence.

The FAA agrees and the rule requires only that passengers be told that they should keep their seat belts fastened while seated.

In addition, one commentator noted that a pre-takeoff briefing is not the appropriate place for the announcement that when the seat belt sign is off passengers should keep their seat belts fastened. The commentator believes that this briefing should be made after takeoff when turning the seat belt sign off. The FAA agrees, and the proposal has been changed accordingly.

Several comments were received concerning proposed § 121.577. These comments recommended that the proposal permit certain beverages and foods to be located at a passenger seat during takeoff or landing of an airplane. One commentator indicated that beverages in small paper or plastic cups or a breakfast roll would not constitute a danger to passengers in the event of an accident. As the FAA stated in Notice 69-33, in an emergency situation requiring evacuation, the litter from food service of any kind (including coffee or rolls) can be hazardous. Therefore, the proposal has not been changed as recommended. However, proposed § 121.577(b) has been revised to make it clear that during takeoff and landing passenger food and beverage trays and serving carts must be secured in their stowed positions, i.e., correctly positioned in their storage compartment and their restraint means, if any, fastened.

Numerous comments were received on the proposal concerning carry-on baggage (§ 121.589). Several comments pointed out that the restraint requirement should not be made mandatory for all seats. The FAA agrees that it is only when baggage is permitted to be stowed under a seat that the seat need be fitted with a means to prevent articles of baggage stowed under it from sliding forward. The proposal has been revised accordingly. Two comments objected to any requirement that carry-on baggage be stowed under a seat. The inconvenience of having to check baggage with no corresponding gain in safety was cited as reason for their objection. The FAA does not agree. Carry-on baggage must be secured to prevent injury to passengers, and to prevent interference with passenger evacuation, in a crash situation. The increase in safety realized from such a requirement far outweighs the inconvenience of checking the baggage. Another comment recommended that the rule permit stowage of carry-on baggage in front of passengers seated facing a bulkhead provided the bulkhead meets the crash impact requirements of paragraph (c) of § 121.589. Section 121.285 already provides for the carriage of cargo, including carry-on baggage, forward of the foremost seated passenger. However, insofar as the recommendation would require the imposition of crash impact loads on bulkheads, it would constitute a substantive change in the existing requirements. Such a change is outside the scope of Notice 69-33. On the other hand, the recommendation appears to have merit and may be the subject of a future rule-making action.

There was also a comment recommending that the carry-on baggage should be restrained in the sideward direction as well as in the forward direction. Such a requirement was not proposed in Notice 69-33 and the FAA believes that most seats provide side restraint. However, since there may be seats that do not, the FAA is looking into the matter and will initiate rule making as needed.

In consideration of the foregoing, Parts 25, 37, and 121 of the Federal Aviation Regulations are amended, effective May 1, 1972.

These amendments are made under the authority of Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, and 1424), and of Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-33

Emergency Exit Arrangement

Adopted: September 14, 1972 **Effective: October 21, 1972**

(Published in 37 F.R. 19607, September 21, 1972)

The purpose of these amendments to the Federal Aviation Regulations is to provide for improved emergency exit configurations of transport category airplanes that are required by Part 121 to have a lockable door installed between the pilot and passenger compartments.

This amendment is based on a Notice of Proposed Rule Making (Notice 70-5) published in the Federal Register on February 3, 1970 (35 F.R. 2412). A number of comments were received in response to the Notice, most of which were favorable. Some comments, however, suggested further changes or clarifications and the FAA's disposition of such comments is set forth hereinafter.

As explained in Notice 70-5, the proposal would assure that airplane type certificated under Part 25 with a lockable door installed between the pilot compartment and the passenger compartment to meet the requirements of Part 121 have emergency exit configurations that do not require the flight crews or the passengers to use that door in order to reach the emergency exits provided for them. It was further proposed that the new exit requirements be made retroactively applicable to all type certificates issued under Part 25 after the effective date of the amendment irrespective of the date of application.

Several commentators objected to the retroactive requirement proposed as new § 25.4 in Notice 70-5. It was stated that for the smaller transport category airplanes nearing type certification, compliance with the proposed standards would require a substantial redesign of the fuselages to add the necessary space in the cockpit area for the installation of a crew compartment emergency exit. Another commentator asserted that the retroactive requirement would place on a manufacturer of smaller transport category airplanes an impossible burden which is not commensurate with any safety benefit that might result. In this connection, the FAA has made a survey of the transport category airplanes in the process of type certification. We agree that for the manufacturers of those airplanes that are not yet certificated, but are relatively far along in the design program and "hardened" in configuration, the retroactive requirement would impose an unreasonable penalty. With respect to the large transport category airplanes and the large jumbo jets for which type certificate applications have been filed, it appears that all have been designed to meet the proposed requirement. In view of the foregoing and upon further consideration, the FAA has determined that the proposed new § 25.4 should be withdrawn.

A number of commentators recomended that certain of the smaller transport category airplanes be excepted from the proposed requirement. One contended that because of the fewer passengers carried, the shorter range and the widespread use of such airplanes as business aircraft, the proposed standards were unnecessary and would restrict design by forcing the construction of larger airplanes. Another commentator, reading into the proposal an FAA intent to regulate only the "ultra-large" airplanes operated by CAB certificated air carriers, recommended that large airplanes operated by air taxi and commercial operators under Part 135 be excepted from the rule. The FAA does not agree that there is justification for an exception to the emergency exit requirement merely because an airplane is operated under Part 135 rather than Part 121. The safety objectives of cockpit security and unobstructed evacuation paths are applicable to all airplanes required to comply with § 121.313(f). However, the FAA agrees that the proposed emergency exit configuration requirement need not be applied to transport category airplanes that have a passenger seating capacity of 20 seats or less. The exclusion of those airplanes from the proposed requirement is consistent with the exception provided in § 25.805 which recognizes the unreasonably difficult design problems associated with providing emergency exits in crew compartments of these airplanes.

Accordingly, proposed § 25.772 has been revised to except from its applicability airplanes having a maximum passenger seating configuration of 20 seats or less.

The FAA does not agree with the comment recommending that further action on the proposal be withheld pending outcome of a CAB investigation of airplane weight limitations for air taxi operators. This proposal is based on the safety aspects of emergency evacuation and flight deck security which are not a part of the referenced CAB investigation.

In response to another comment, it should be noted that the intent of Amendment 121-67, adopted subsequent to the issuance of Notice 70-5, was to amend § 121.583(a) to provide an exception from the requirements of § 121.313(f) for airplanes carrying only those persons specified in that regulation. However, the comment has called to our attention an inadvertent reference to § 121.313(i) rather than to § 121.313(f) in the text of § 121.583 as made by Amendment 121-67. Accordingly, § 121.583(a) is amended to make this correction. In addition, at the request of industry, in order to assure that this operating exception to § 121.313(f) is clearly recognized, § 25.772 has been enlarged to cite § 121.583(a) specifically.

One commentator expressed concern that the proposal would tend to isolate the flight crew from the passengers and thus prevent the crew from having overall command of an emergency evacuation. The proposed rule is an aircraft certification requirement intended to provide improved evacuation capability for both crew and passengers without impairing cockpit security. Nothing in the proposal would prevent flight crew entry into the passenger compartment or preclude the flight crew from taking command during an emergency evacuation.

Several commentators suggested that an exception to the proposed emergency exit requirement be allowed by the installation of automatic unlocking doors, or doors that lock on the passenger side but are freely operable on the crew side, or by use of special hinges or knock-out panels, or by demonstration of freedom of movement through the door. It is the intent of the rule that under any foreseeable conditions of damage or malfunction of the crew compartment door, no airplane occupant be denied access to his required emergency exit. Since none of the conditions suggested provide for the contingency of a jammed door, the FAA does not agree that they provide acceptable alternatives.

One further comment recommended that reference to flight crew members be deleted in proposed § 25.772 because of the difficulties encountered in providing escape devices for descent from the high cockpits of the large jumbo jets airplanes. The contention was that since the volume of such devices makes it impractical to stow them in the cockpit area, the flight crew should be allowed egress through the pilot compartment door. However, the intent of the proposal, to ensure flight crew egress in the event of an emergency evacuation, is as applicable to the jumbo jet category as to any other transport category airplanes. Moreover, because of the dimensions involved, it is even more important that the flight crews of the larger airplanes have readily accessible exits. With deletion of the proposed retroactivity requirement, no undue redesign burden is being placed on the manufacturers of airplanes now in the process of certification. For future airplanes, there appears no reason why suitable escape devices may not be incorporated at the initial design conception.

Interested persons have been afforded an opportunity to participate in the making of this amendment and due consideration has been given to all relevant matter presented.

In consideration of the foregoing, Parts 25 and 121 of the Federal Aviation Regulations are amended as follows, effective October 21, 1972.

These amendments are made under the authority of sections 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25–34

Rear Exit Security: Large Passenger-Carrying Turbojet Powered Airplanes

Adopted: November 24, 1972 **Effective: December 31, 1972**

(Published in 37 F.R. 25354, November 30, 1972)

The purpose of these amendments to Parts 25 and 121 of the Federal Aviation Regulations is to provide additional security on certain large passenger-carrying turbojet powered airplanes operated under Part 121 by requiring that each ventral exit and tailcone exit be designed and constructed so that it cannot be opened during flight. These amendments also apply to air travel clubs certificated under Part 123 and to air taxi operators certificated under Part 135, when conducting operations governed by those Parts with the large airplanes.

Interested persons have been afforded an opportunity to participate in the making of these amendments by a Notice of Proposed Rule Making (Notice 72-15) issued June 20, 1972, and published in the Federal Register on June 24, 1972 (37 F.R. 12507) and due consideration has been given to all comments received in response to the Notice, insofar as they relate to matters within the scope of the Notice. Except for editorial changes, and except as specifically discussed hereinafter, these amendments and the reasons therefor are the same as those contained in the Notice.

Several commentators objected to the requirement in proposed § 25.809(j)(1) and § 121.310(k)(1) that means must be provided so that takeoff cannot be started if either the ventral exit or tailcone exit is not locked. They based their objection on the possible catastrophic results of a malfunction or failure in the currently available means that could be used to implement this requirement, for example, systems providing for the locking of brakes or throttles by electrical signals from the stair lock. In this regard, a number of means were suggested by commentators to assure that the ventral exit could not be opened during flight, but that it still would be available for use as an emergency exit. The FAA agrees with those comments, and, accordingly, the proposal that means be provided so that takeoff cannot be started if the ventral exit or tailcone exit is not locked is not adopted in this amendment. However, under the rule as adopted, when the airplane becomes airborne the design and construction characteristics of each ventral exit and tailcone exit must be such that it cannot be opened during flight.

Certain comments contended that altering the design of an aircraft is not an effective means of overcoming the problems of hijacking, because simple devices can be overcome by the hijacker and more complicated devices create additional risk in the operation of the aircraft. One comment pointed out that it is patently impossible to add a lock to an emergency exit without statistically reducing the reliability of that exit. However, the FAA does not believe that, because a device installed in compliance with the rule may be simple in design, it will necessarily also be simple for a hijacker to overcome it. Nor does the FAA believe that compliance with the rule, as adopted, will reduce the reliability of the exits in an emergency.

One commentator recommended that the rule specify that the ventral exit be available for normal and emergency ground operations. The FAA does not agree that a rule change in this respect is necessary, since the amendment as adopted herein in no way conflicts with other rules dealing with the availability of exits for emergency egress in an actual emergency.

Several commentators recommended that an appropriately worded placard be installed in a conspicuous location near the means of opening each ventral exit and tailcone exit, stating that the exit cannot be opened during flight. The FAA agrees, and this requirement is added to the proposed amendments.

One commentator suggests that the proposed rule should not be applied to air travel clubs, because the makeup of their membership and their financial structure makes it highly unlikely that they would be subjected to the kind of hijacking and extortion the proposed rule is intended to prevent. The FAA does not agree. The proposal was intended to prevent all hijacking of certain large aircraft engaged in operations required to be conducted in accordance with Part 121 and the amendment is applicable to all such operations.

One commentator objected to the rule, stating that it is unnecessary since the proper response to any hijacker is to refuse all of his demands for ransom, whatever the cost. The FAA does not agree. As stated in the Notice, every possible step must be taken to deter persons from boarding aircraft for the purpose of hijacking them and escaping by parachute. The purpose of these amendments is to make it clear that any attempt to hijack a large passenger-carrying turbojet powered airplane and escape therefrom by parachute will be a futile effort.

While the Notice proposed to make the amendment to § 121.310 effective 6 months after the effective date of the rule, the rule as adopted provides for an 8-month compliance period to allow additional time for design, manufacture, and installation, where modifications are needed to conform to the rule.

In consideration of the foregoing, and for the reasons given in Notice 72-15, Parts 25 and 121 of the Federal Aviation Regulations are amended, effective December 31, 1972.

(Section 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958; 49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425. Section 6(c) of the Department of Transportation Act; 49 U.S.C. 1655(c).)

Amendment 25-35

Engine Rotor System Unbalance

Adopted: January 8, 1974 **Effective: March 1, 1974**

(Published in 39 F.R. 1831, January 15, 1974)

The purpose of these amendments to Parts 25 and 33 of the Federal Aviation Regulations is to require on turbojet engine powered transport category airplanes an indicator to indicate rotor system unbalance, and to require that a means of connecting the indicating system be provided on turbojet engines.

These amendments are based upon two of the proposals contained in a Notice of Proposed Rule Making (Notice 71-12) published in the Federal Register on May 5, 1971 (36 F.R. 8383). Numerous comments were received in response to Notice 71-12, which the FAA is currently reviewing. The FAA believes that it is in the interest of safety to adopt these two proposals herein without delay, while the final disposition of the remaining proposals is being completed. A number of comments relating to these two proposals were received in response to the notice and except for those indicating agreement with the proposals or merely repeating issues discussed and disposed of in the Notice, the FAA's disposition of the comments is set forth herein.

Several commentators expressed doubt as to the reliability of presently available engine vibration indicating systems and suggested proposed § 25.1305(d)(3) not be adopted. They further pointed out that the present equipment is expensive and difficult to maintain. As stated in the notice, the FAA is aware that the currently available vibration detectors are not as reliable as the engines they monitor and to that extent, they may impose an economic penalty; however, a rotor system failure can be catastrophic and the contributions to flight safety gained from a vibration monitoring system that provides the flight crew with an appropriate vibration warning far outweighs any difficulties that may be exverienced. The value of the system has been recognized by the aviation industry in that vibration monitoring systems have been voluntarily installed in most turbine powered transport category airplanes currently in produciton.

Several commentators expressed concern that inadvertent engine shutdowns might possibly result from the failure of the flight crew to differentiate between normal and abnormal engine vibration readings. They point out that variations in vibration levels exist between different engines of the same type as well as on the same engine at different flight and power conditions. The rule, however, does not require that a level of acceptable vibration be specified. It merely requires an indication of "rotor system unbalance" in the engine as installed in the aircraft. The indicator may be employed to sense a trend of vibrations over a period of time, rather than a specific level at a particular instant. The FAA considers the addition of a vibration indicator to be necessary in the interest of safety and that flight crews will be able to properly interpret the indicator readings.

One commentator expressed concern that the proposed vibration indicating system could not be used effectively as the principle means of detecting engine failure. The intent of the amendment does not, however, make the vibration indicator the sole or exclusive monitoring indicator. Rather, it is an addition to the present engine instrumentation and provides additional information on engine conditions.

One commentator proposed use of the term "mounting provisions" instead of "connection" in proposed § 33.29(b) in order to make the rule more general. The term "connection," is a general term and the FAA considers it more descriptive and less restrictive than the term "mounting provision."

It was suggested by a commentator that some engines with damped rotors would not reflect rotor unbalance with an externally mounted vibration monitoring system. The amendment to § 33.29(b) does not require that only an externally mounted system be utilized, but permits any system which would indicate an unbalance of the rotor system. To ensure this intent, the term "vibration monitoring" has been deleted. This change makes the adopted rule less restrictive than the proposed rule while still requiring a system which will indicate rotor system unbalance.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1425), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, Parts 25 and 33 of the Federal Aviation Regulations are amended as follows, effective March 1, 1974.

Amendment 25–36

Aircraft and Aircraft Engines—Certification Procedures and Type Certification Standards

Adopted: September 20, 1974 **Effective: October 31, 1974**

(Published in 39 F.R. 35452, October 1, 1974)

The purpose of these amendments is to change the procedural requirements relating to the type certification of aircraft and aircraft engines, to update and improve the airworthiness standards applicable to the type certification of aircraft engines, and to incorporate new standards applicable to engines used on supersonic airplanes. In addition, other new airworthiness standards are made applicable to aircraft on which engines type certificated to previous standards are to be installed.

These amendments are based on the Notice of Proposed Rule Making (Notice No. 71–12) published in the Federal Register on May 5, 1971 (36 F.R. 8383). Except for minor editorial changes, and except as specifically discussed hereinafter, these amendments and the reasons therefor are the same as those proposed in Notice 71–12. Numerous comments relating to these proposals were received in response to the Notice and except for those indicating agreement or merely repeating issues discussed and disposed of in the Notice, the FAA's disposition of the significant comments is discussed below. In general, comments received that were beyond the scope of the Notice are not discussed but will be retained for consideration in connection with other rule-making projects as appropriate. Based on the relevant comments and upon further review within the FAA, a number of changes have been made to the proposed rules. In addition, various non-substantive changes of a clarifying and editorial nature have been made. Since these changes impose no additional burden on any person, they may be adopted without further notice and public procedure.

Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matter presented.

Two of the proposals of the original Notice concerning engine rotor system unbalance (§§ 25.1305 and 33.29) have been implemented by a separate rule-making action, Amendments 25–35 and 33–5, effective March 1, 1974, that were published in the Federal Register on January 15, 1974 (39 F.R. 1831).

The following discussion is keyed to the like-numbered proposals contained in Notice No. 71–12:

PART 1—DEFINITIONS AND ABBREVIATIONS

Proposal 1—One commentator objected to the inclusion of a turbo-supercharger as part of the engine in the proposed definition of aircraft engines in § 1.1, asserting that in some instances it should be classified as an accessory. However, the intent of the proposal was that turbo-superchargers be included as part of the engine whether or not they are additionally classified as accessories. The definition as adopted has been revised to clarify that a turbosupercharger is part of an engine whether or not it is also an appurtenance or an accessory.

Proposal 2—Several commentators suggested that the term "stop" be deleted from the definition of "idle thrust" as proposed in § 1.1 since a stop is normally associated with the power control lever or throttle, rather than with the engine fuel control device as suggested in the Notice. The FAA agrees with the comment to the extent that the term "idle thrust" should be related to the power control lever and has changed the definition by replacing the term "fuel control device" with "power control lever." Since the term "stop" is appropriate with this revision, it need not be deleted.

One commentator pointed out that several of the proposed amendments used the term "type" in reference to engines and that the word "type" was defined in relation to aircraft in § 1.1 but not to engines. For internal consistency, the definition of "type" has been amended to include the meaning of the term with respect to the certification of aircraft engines.

PART 21—CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

Proposal 1—Several commentators suggested that the stress analysis called for in proposed § 21.15(c) for the engine rotor, spacer, and rotor shaft would not normally be available at the time of application for a type certificate, but would be available before actual certification. The FAA agrees and, upon further consideration, has determined that inclusion of the requirement under the type certification standards will allow an applicant to complete and submit a stress analysis after application for a type certificate and before certification. The requirement for a stress analysis has therefore been removed from § 21.15(c) and relocated in a new § 33.62 under the design and construction requirements for turbine aircraft engines.

Proposal 2—Several commentators recommended deletion of that portion of the proposed § 21.35(f) which requires 300 hours of flight test operations for aircraft incorporating engines of a type not previously used in a type certificated aircraft. They contended that the rule discriminated against new engine types, and that unnecessary economic hardships and delays in the aircraft certification program would be imposed. However, experience with newly certificated engine types has demonstrated to the FAA that there is a need for more thorough flight testing of newly certificated engine types, and the regulation with respect to hours of operation is adopted as proposed. Furthermore, the suggestion of one commentator that allowance be made for the use of experimental engines that differ only in minor ways from the type certificated engine has not been adopted because the FAA believes it could lead to uneven administration of the rule.

One commentator questioned whether the phrase "engines that conform to a type certificate" in subparagraph (f)(1) required just one or a full complement of the newly type certificated engines in a multi-engine aircraft. As indicated in the explanation in the Notice, the intent of the FAA is that "engines" means all the engines in the aircraft. To eliminate any ambiguity, the wording has been changed to specifically call for a full complement of engines.

Proposal 3—No public comment was received on the proposal to amend § 21.97 and the section is adopted as proposed.

PART 23—AIRWORTHINESS STANDARDS: NORMAL, UTILITY, AND ACROBATIC CATEGORY AIRPLANES

Proposal 1—One commentator questioned whether proposed § 23.951(b) would prohibit several fuel tanks from gravity feeding through non-return valves to a single collector box from which the fuel pumps would draw fuel. Such an arrangement is not prohibited and the rule would allow any combination of tanks to be used so long as means are taken to prevent air from being introduced into the system.

In response to the suggestion contained in several comments, the icing requirement of paragraph (c) of proposed § 23.951 has been reworded to clarify that it is applicable solely to turbine engine aircraft, since fuel icing is peculiar to turbine fuels. Additionally, since the requirement is intended to preclude interrupted functioning of the fuel system rather than to require operation for an indefinite time, the rule has been revised to require "sustained" operation rather than "continuous" operation.

Proposal 2—Several commentators questioned whether an applicant would have to comply with amended § 23.997, as proposed, if the similar rule in § 33.67 had already been complied with by the engine manufacturer. The FAA proposed the new requirements to assure that newly certificated aircraft would meet the standards prescribed in § 33.67. Thus, if the aircraft manufacturer incorporated an engine which had been type certificated under new § 33.67 the fuel system would already conform to the rule and nothing further would be required. If, however, the aircraft manufacturer incorporated an engine which had not been certificated under the new § 33.67 he would have to take the necessary action to comply with new § 23.997.

Several commentators questioned whether the proposed rule would require that each and every filter in the fuel system, including small screens and so-called "last chance filters," meet the requirements of paragraph (a) through (d) of proposed § 23.997. The FAA intended that at least one filter upstream of the fuel metering device and the engine driven displacement pump meet these requirements, and the section has been clarified accordingly.

In response to a question raised by one commentator concerned with the availability of heat for the required filter or strainer, the FAA wishes to point out that the requirement for icing protection in turbine engine fuel systems, set forth in § 23.951, applies to the entire fuel system.

As proposed, § 23.997(b) would require a drain. Upon further consideration it has been determined that an equivalent of the drain could be provided by having the strainer or filter easily removable for drain purposes and this alternative has been incorporated into the regulation.

Proposal 3—One commentator questioned whether the oil sump of a dry sump engine would be considered as expansion space under the proposal. If the sump is in fact part of the oil tank, then the sump provides the expansion space specified in § 23.1013(b)(1). Further amendment of the requirement is not considered necessary and § 23.1013(b)(1) is adopted as proposed.

One commentator requested clarification of the phrase "that might reduce the flow of oil," used in proposed § 23.1013(e). Several other commentators suggested that the phrase was inconsistent with, but should be identical to, proposed § 25.1013. The FAA agrees with these comments and has revised the section to make it consistent with § 25.1013 in this respect, by specifying that any oil tank outlet screen or guard may not reduce the flow of oil below a safe value at any operating temperature.

Proposal 4—One commentator suggested that the more technically correct term "differential pressure" be used in place of "pressure," in paragraph (c) of § 23.1015. The FAA believes, however, that the present term is adequately understood in the industry, and has not caused any misunderstanding in the past. The paragraph is therefore adopted as proposed.

Proposal 5—Several commentators expressed the belief that the proposed § 23.1019 might be interpreted to require each and every oil strainer or filter in the system including small so-called "last chance" filters to conform to all the requirements of paragraph (a). The intent of the FAA is to require at least one oil strainer or filter that will filter all the oil that passes through the lubricating system while conforming to the requirements of the section. The rule as adopted has been reworded to make this clear. Another commentator objected to the word "conveys" as inappropriate in the lead-in sentence of paragraph (a). The FAA agrees and has changed the wording to refer to a strainer or filter through which all of the engine oil flows.

Several commentators interpreted the requirement of subparagraph (a)(1) for normal oil flow through the bypass as possibly requiring identical flow and proposed the word "adequate" in place of "normal." The FAA does not agree that the word "normal" means identical and used the word normal to mean normal for the system within its operating range. Therefore, the wording as proposed has been retained.

One commentator stated that filters should be serviced on a routine and normal maintenance basis rather than relying upon an indicator as proposed in subparagraph (a)(3). In this connection it should be noted, however, that the rule does not call for relaxing of any maintenance procedures but adds an additional item which will contribute to safety by providing a quick means of inspecting for possible filter contamination.

It was assumed in one comment that the standard engine oil pressure gauge would qualify as an "indicator" as required in proposed subparagraph (a)(3). While it was considered that a separate indicator would be provided, nevertheless, if the applicant can demonstrate that the oil pressure gauge would adequately perform the function of the indicator, a separate indicator would not be required. Upon further consideration, the function of the indicator in terms of contamination of the screen has been reworded for clarity.

Several commentators questioned whether the wording of subparagraph (a)(4) was realistic in requiring that no contaminants be released through the filter bypass. As proposed, the requirement stated an absolute prohibition against release of contaminants. The FAA agrees that the intended purpose may be met by requiring the bypass to be designed to minimize release of contaminants, and the requirement is reworded accordingly.

Proposal 6—Several commentators objected to the requirement in proposed § 23.1093 for operation in falling and blowing snow on the basis that no standard is specified as to the intensity or the amount of falling snow or the degree of blowing involved. They further point out that no uniform means are provided for demonstrating compliance with the section and that a small or even minute amount of snow might satisfy the letter of the law of this section. One commentator offered detailed standards that could be adopted. However, it was not the intent that specifications for all possible conditions be included in the regulation but, rather, that an applicant select the limitations desired for his airplane and then demonstrate the ability to operate within those limitations.

Several commentators asserted that the specified liquid water content of 2 grams per cubic meter was not representative of actual conditions and would result in more stringent requirements for ground operation than for flight, while another suggested that the requirement for icing protection at idle should be applicable "on the ground" rather than at sea level. Upon further consideration, the FAA agrees that a reduction of 0.6 grams would provide an adequate and safe standard for icing protection at idle conditions on the ground and the requirement has been changed accordingly.

One commentator objected to the requirement for icing protection for 30 minutes at idle, stating that there was insufficient bleed air to adequately meet the requirement for this period of time. However, experience has demonstrated that it is practical and necessary for safety of flight, and that protection for the engine during prolonged idle prior to takeoff is essential to safety of operation. The proposal does not restrict the means for icing protection to engine bleed air, as suggested by the commentator, but allows any means or combination of means which the applicant chooses. With respect to bleed air, the intent of the requirement is that icing protection at idle be provided when the bleed air available for icing protection is at its critical condition. The section has been reworded to make this clear.

Proposal 7—Amendment 23-14, effective December 20, 1973, published in the Federal Register on November 19, 1973 (38 F.R. 31816), amended § 23.1183(a) to require that lines and fittings and components carrying gas, air, or flammable fluids in any area subject to engine fire conditions must be at least fire resistant. That amendment also amended the heading of the section, while retaining the requirement that flexible hose assemblies must be approved. Therefore, the section as amended by this amendment, contains the provisions made effective by Amendment 23-14 in addition to those proposed in Notice 71-12, including the revision of the latter discussed below. Inasmuch as the heading proposed in Notice 71-12 is inappropriate to the section as amended by Amendment 23-14, the heading adopted by the amendment is retained.

Stating that proposed § 23.1183, which concerns engine fire protection, is inappropriately included with aircraft airworthiness standards, one commentator suggested that it more correctly belongs in Part 33 relating to engine airworthiness requirements. However, while this and other sections do relate to engine airworthiness, they are included also in Part 23 and the other aircraft certification parts since it is the intent that aircraft certificated under applications made after the adoption of these amendments conform to the new updated sections of Part 33, whether or not they incorporate engines type certificated under the updated Part 33. Thus, to cover cases where such aircraft incorporate engines certificated under applications made before adoption of these amendments, the new engine standards that are appropriate are made effective as to the aircraft by being incorporated in the aircraft airworthiness sections.

One commentator questioned whether integral oil sumps on smaller reciprocating engines were considered to come within the meaning of flammable fluid tanks as that term was used in proposed § 23.1183. The FAA did not intend that they be included, and the rule as adopted specifically provides that integral oil sumps of less than 20 quart capacity need not be fireproof nor be enclosed by a fireproof shield.

Proposal 8—As a result of the issuance of Amendment 23-14 (38 F.R. 31816), which contains new paragraphs, § 23.1305(q) and (r), the proposed paragraphs (q), (r), (s), and (t) are redesignated (s), (t), (u), and (v), respectively. The following discussion is keyed to the new designations.

One commentator questioned whether the fuel strainer or filter indicator referred to in § 23.1305(t) were required on all filters, even "last chance" filters. Consistent with the requirements applicable to the strainers or filters themselves, § 23.1305(t) has been revised to make clear that the indicator required is for a fuel strainer or filter required under § 23.997. Similarly, § 23.1305(t) and (u) have been reworded in order to be consistent with §§ 23.997 and 23.1019, respectively, in regard to the degree of contamination that must be indicated. In response to a further comment, § 23.1305(t) has been reworded to clarify that the desired indication is of the occurrence of contamination rather than the more stringent requirements of the degree of contamination as suggested in the Notice. This change achieves consistency between paragraphs (t) and (u).

One commentator questioned whether other presently installed gauges for other functions could be used as "indicators" to indicate the functioning of a heater as required in paragraph (v). As discussed above, in connection with the indicators required for oil strainers or filters, the FAA anticipates that the requirement will be met by installation of gauges to indicate the functioning of heaters. However, if a clear and positive indication can be obtained from other gauges used to portray functions different than direct heater functioning, the requirements of the section are met.

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

Proposed changes to §§ 25.951 (Proposal 1), 25.997 (Proposal 3), 25.1015 (Proposal 5), 25.1019 (Proposal 6), and 25.1093 (Proposal 7) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. As adopted, these Part 25 sections set forth the same requirements as proposed in Notice 71-12 except as they have been modified for the reasons given in the preamble discussion of the like-numbered Part 23 sections.

Proposal 2—No comments were received in response to the proposed deletion of § 25.977(b). That paragraph is accordingly revoked and marked reserved.

Proposal 4—The exemption contained in the last sentence of § 25.1013(a), concerning fireproofing of an integral oil sump of less than 20-quart capacity on a reciprocating engine, has been removed from this section and placed in § 25.1183(a). This action involves no substantive change and achieves consistency with the parallel Part 23 section.

Proposal 8—Section 25.1183(a) has been further amended in connection with changes to § 25.1013(a) as noted under Proposal 4.

Proposal 9—Section 25.1305(c) has been amended so that it is substantively the same as the parallel provision of § 23.1305. The related Part 23 preamble discussion is applicable. The proposed new subparagraph 25.1305(d)(3), concerning an indicator to indicate rotor system unbalance, has already been adopted by a separate rule-making action (Amdt. 25-35, 39 F.R. 1831).

One commentator stated that aircraft fuel systems have been designed without cockpit controlled fuel heat; therefore there is no need in proposed subparagraph (c)(8) for an indicator to indicate the proper functioning of any fuel heater. The section however only requires an indicator if a heater is used and the FAA believes it would supply necessary information to indicate heater functioning.

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

Proposed changes affecting §§ 27.951 (Proposal 1), 27.997 (Proposal 2), 27.1013 (Proposal 3), 27.1015 (Proposal 4), 27.1019 (Proposal 5), 27.1093 (Proposal 6), 27.1183 (Proposal 7), and 27.1305 (Proposal 8) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. The proposed amendments set forth in Notice 71-12 have been adopted except as explained in the preamble discussion of the like-numbered Part 23 sections.

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

Proposed changes affecting §§ 29.951 (Proposal 1), 29.997 (Proposal 2), 29.1013 (Proposal 3), 29.1015 (Proposal 4), 29.1019 (Proposal 5), 29.1093 (Proposal 6), 29.1183 (Proposal 7), and 29.1305 (Proposal 8) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. The proposed amendments set forth in Notice 71-12 have been adopted except as explained in the preamble discussion of the like-numbered Part 23 sections.

PART 33—AIRWORTHINESS STANDARDS: AIRCRAFT ENGINES

Proposal 1—The comments received in response to proposed § 33.5 focused principally on the overhaul instructions that would be required by paragraph (e). The comments revealed widespread misunderstanding of the effect of requiring the engine manufacturer to set out the frequency of overhauls. In this connection, the FAA wishes to point out that overhaul instructions are necessary upon type certification because an engine might require overhaul at any time thereafter, and the ability to perform an overhaul should not be limited by lack of instructions. Furthermore, the manufacturer's statement of overhaul frequency is not established as an operating limitation but operates merely as a recommendation; it does not preclude the establishment of different overhaul intervals, nor does it preclude the "piecemeal" overhaul practice followed by operators using continuous airworthiness maintenance programs. It should be noted, however, that the initial overhaul time established under § 33.90 and referred to in § 33.7(c)(17) is an operating limitation that must be complied with regardless of the adoption of any other practice; the initial overhaul, whether accomplished "piecemeal" or otherwise, must be completed within the time established.

With regard to a question raised by one commentator concerning the requirements in § 33.5(e)(2) that certain component life limits be specified in the required instructions, the FAA wishes to call attention to the fact that no separate requirement is thus established that would have any effect on operators of the engines. The life limits of all components requiring replacement are established under other sections of Part 33 as operating limitations that must be complied with, and their publication in the required instructions is a convenience to operators.

Upon further review, § 33.5(a)(1) is revised to include a requirement that the installation instructions contain the maximum allowable loads for engine mounting attachments and related structure, which are required to be determined in complying with § 33.23. Similarly, § 33.5(a)(2) is revised to include a requirement for description of the pipes, wires, cables, ducts, and cowling covered by that section. That information is considered essential for installation, and FAA practice has been to require it for compliance with prior §33.5.

Proposal 2—The effect of proposed § 33.7 was misunderstood by a number of commentators who objected to various ratings and limitations listed therein. Contrary to the apparent belief of those commentators, no ratings or limitations would be established independently under § 33.7; the section merely contains a list of ratings and limitations established either under applicable requirements of Part 33 that predate the Notice, or under proposed new requirements contained in the Notice. Consideration was thus given to the substance of the comments as they related to substantive requirements proposed in the Notice. Discussion of comments directed to § 33.7 but relating to proposed new requirements is found with other comments under the appropriate section. However, as a result of such comments, one substantive change has been made that affects § 33.7; no rating or limitation need be established for turbine engine internal cooling air flow, and proposed § 33.7(c)(12) has therefore been deleted, with attendant necessary renumbering of the succeeding subparagraphs. Other changes of an editorial nature have been made for internal consistency between § 33.7 and other Federal Aviation Regulations.

Proposal 3—No public comment was received on the proposed deletion of § 33.13, and the section has been revoked and marked "reserved."

Proposal 4—Several comments were received that contained objections to the start-stop stress cycle described in proposed § 33.14 as not being representative of a typical operating cycle that would produce the stresses to be accounted for by the requirement. In particular, there was objection to the requirement that disc and spacer temperatures be stabilized after stopping the engine in order to complete a cycle. The FAA agrees that final temperature stabilization should not be necessary where an applicant can show that the components experience the complete stress range without such stabilization, and the definition of a start-stop stress cycle as adopted includes a provision to allow for such a showing.

Another commentator suggested that the operating limitation be defined as the number of cycles to a detectable crack rather than to failure. The FAA regards a crack as a failure and the rule as adopted applies not only to cracks but to other types of failures which may occur prior to the occurrence of a detectable crack.

A commentator recommended that spacers be deleted from the section because they would not normally be critical. The FAA disagrees; spacers are a critical item in low cycle fatigue, and the requirement, in this regard, is adopted as proposed.

One commentator stated the belief that the establishment of component life limits would result in a complicated and time-consuming process for extending component life. The FAA points out that the listing of this limit on the type certificate as required by this section provides only an initial limit and will not in any way complicate the procedure for extending the limit. In this connection, the section as adopted is revised to clarify that the required operating limitations and the provision for increasing them apply individually to each rotor disc and spacer.

Proposal 5—Several commentators objected to the new standard of protection proposed in § 33.17(b) for external lines, fittings, and components as necessary because the matter is adequately covered in paragraphs (a) and (c) of that section, while another commentator asserted that, due to considerations of airflow and venting, the requirement should be imposed only on the airframe. The FAA does not agree with these positions. The new requirement in (b) for protection against ignition of leaking flammable fluids is necessary to deal with possible impingement of such fluids on hot surfaces. Furthermore, since engine design necessarily includes considerations of airflow and venting, this requirement in Part 33 will assure that those considerations take account of possible ignition of leaking flammable fluid that could result from its impingement on engine components.

In response to comments questioning the applicability of proposed § 33.17(c) to integral oil sumps on the smaller reciprocating engines, the requirement as adopted is revised to exclude such sumps having less than a 20-quart capacity. The requirement is thus made consistent with the parallel requirements in the aircraft airworthiness parts.

One commentator believed that a clear definition of "fireproof" and "fire resistant" was lacking in the regulations and suggested that temperature, duration and flame intensity should be specified as part of any definition. The definitions in § 1.1 of the regulations include both "fireproof" and "fire resistant" and any further changes to these definitions would be outside the scope of the Notice.

One commentator questioned whether under paragraph (e), the accumulation of fluid is interpreted as occurring inside of the engine and suggested that the section should specify unwanted flammable fluid. The FAA agrees that the section is intended to refer to unwanted flammable fluid and is directed to areas internal to the engine. The requirement as adopted is reworded accordingly.

Proposal 6—The comments received in response to proposed § 33.25 expressed general agreement with the intent of the requirement as understood by the commentators. However, several of the comments indicated a need for clarification regarding the applicability of limit loads to accessory drives and mounting attachments. The FAA agrees that the intent of the proposal was that the limit load requirement apply to accessory drives and mounting attachments and the section as adopted is reworded to make this clear.

In addition, as suggested by one commentator, a provision has been added to make clear that the use of engine oil for lubrication of accessory drives and mounting attachments is permitted, with appropriate sealing provisions.

Proposal 7—It was pointed out that reference to "excessive speed, temperature, and vibration" in proposed § 33.27(a) was vague in view of the very specific requirements in proposed paragraph (d). Since it was the intent of the proposal to relate the two requirements, § 33.27(a) as adopted is revised to clearly refer to the specific tests included in the section.

Several commentators objected to the speeds proposed in the overspeed tests required in § 33.27. They expressed the opinion that the rotor speed strength demonstrations which are currently accepted by the FAA and which are 5 percent lower in all cases than the proposed requirements demonstrate an adequate margin of strength.

In this connection, one commentator pointed to 6 million hours of service experience with no disc bursts. The FAA finds compelling merit in these comments and upon further consideration the overspeed requirements as adopted are 5 percent less than those proposed.

Several commentators believed that the proposal to use a test article fabricated with minimum qualities allowed by the specification was an impractical requirement. They expressed the opinion that to conform to the proposal as written would require a component made with all the minimum properties of the specifications, a condition which could not be met. The FAA agrees with these comments and upon further consideration has deleted the proposal.

Several commentators objected to the proposed paragraph (c) of § 33.27 regarding cooling airflow as being too restrictive. They pointed out that in designs where there is more than one cooling passage, one passage could be blocked and still allow passage of an adequate flow of cooling air. While this might be less than normal cooling airflow it might still ensure adequate cooling. The FAA agrees that the proposed requirement would not accomplish the intended purpose and, in connection with the deletion of other proposed requirements relating to cooling airflow that were determined to be impracticable (see discussion relating to §§ 33.7 and 33.87), the section is adopted without the proposed paragraph (c).

Proposal 8—One commentator expressed the opinion that the instrument connection markings required in proposed § 33.29 would be unnecessary if it could be shown that there was no possibility of an instrument being connected to the wrong connection. The FAA agrees that this would satisfy the requirements of the rule and, accordingly, the section as adopted is revised to specifically allow this. In addition, the section has been revised by deletion of the word "new" which was inadvertently included in the proposal, to clarify that it applies to all engine limitations.

The proposed requirement relating to rotor system unbalance contained in proposed § 33.29(b), as noted previously in this preamble, has been adopted in a separate rulemaking action (Amdt. 33-5; 39 F.R. 1831).

Proposal 9—The only public comment received in response to the proposed new § 33.42 recommended deletion of the requirement but gave no reason for the recommendation. The section is adopted as proposed.

Proposal 10—A comment was received that questioned the speed range that would be applicable to the proposed requirement in § 33.43(a) for a vibration survey with a cylinder not firing. As proposed, the requirement implies the same speed range that is applicable to the engine with all cylinders firing. The FAA agrees that this would be impractical and the requirement is revised to specify that the applicable speed range is from idle to maximum desired takeoff speed rating.

Several commentators questioned whether the vibration test survey specified in paragraph (a) required the same propeller used for the endurance test or a propeller of the same configuration. The FAA intended that the same configuration of propeller could be used for the tests and the rule as adopted is revised to clarify the intent for both propellers and loading devices.

One commentator recommended that § 33.43(a) be revised to exclude the propeller shaft or other output shafts from the vibration survey. The FAA does not agree that they should be excluded since they are the most vital components requiring vibration measurements and tests. However, this does not include any accessory drive shafts, which are required to be loaded under § 33.43(c) in order to assess the effects of such loads on the propeller or other output shaft.

One commentator regarded that the number of cycles to demonstrate compliance for fatigue testing of steel shafts specified in § 33.43(b) should be 10 million rather than 10½ million cycles. The FAA agrees that 10 million cycles represents an accepted standard and the requirement is revised accordingly.

A commentator recommended that § 33.43(c) which requires accessories to be loaded during the vibration tests be deleted as being unnecessary for torsional surveys. The FAA does not agree; the purpose of the test is to disclose possible adverse vibration effects, including any that might be contributed by accessories.

Proposal 11—Several commentators objected to the proposed § 33.45(b) requirement for a recalibration after the endurance test as being impracticable and unnecessarily adding to the endurance test. They suggested that the intent of the section, to ensure that any power loss during the endurance test be determined, could be met by modifying the rule to require a "power check" in place of a recalibration. The FAA agrees that a full recalibration is not required to determine power loss and the section is revised to require a power check in place of a recalibration. In addition, since the section permits use of measurements taken during the final portion of the endurance test, reference to the finish of that test has been deleted.

Proposal 12—Upon further consideration, the parenthetical statement in the first sentence of paragraph (a) of proposed § 33.49 is revised to clarify that the additional testing requirements that apply to a turbosupercharger are completely covered in § 33.49(e)(1)(iii) (proposed § 33.49(e)(1)(iv)). An applicant may elect to run the engine-turbosupercharger combination an additional 50 hours in complying with that requirement, but it is not necessary to do so.

One commentator felt that in § 33.49, the accessory loading provision referred to in paragraph (a) could be interpreted to require the limit load to be applied during all operations. The intent of this rule is to require limit loads only during operation at rated maximum continuous power and rated takeoff power, and the section is revised accordingly.

One commentator recommended that instead of requiring maximum cylinder temperatures during all of the endurance running at maximum and takeoff powers that a shorter time period would adequately demonstrate cylinder assembly integrity. The FAA agrees with the recommendation and the rule as adopted requires testing with cylinder and oil inlet temperatures specified, for 35 hours, the time currently used in certification practice. Furthermore, the FAA agrees with another commentator that as long as the cylinder temperatures are monitored the intent of the section will be met, and the requirement is revised to refer to cylinder temperature, deleting reference to the cylinder barrel and head.

A commentator recommended that the altitude testing requirements for turbosupercharged engines be deleted and the tests be run at sea level condition. The FAA does not agree. The altitude testing requirements are necessary. However, the section as adopted is revised by rewording the lead-in sentence of § 33.49(e) to allow as an alternative that altitude tests may be simulated, and by deleting proposed § 33.49(e)(1)(iii).

Proposal 13—Several commentators objected that the proposed requirement in § 33.55(b) that all adjustment settings and functioning characteristics that can be established independent of installation on the engine be unchanged at teardown is unnecessarily restrictive. The FAA agrees that the intent of the proposal would be satisfied if those functioning characteristics remain within limits established at the beginning of the endurance test, and the requirement is revised accordingly.

Several commentators believed that the requirement proposed in § 33.55(c) that components conform to the type design after the endurance test was too severe, especially since this would require parts to remain within drawing tolerances. The FAA does not agree. The type design includes dimensions within which a component may change in service. A component that sustains wear beyond those limits during a 150-hour endurance test has not met minimum airworthiness standards.

Proposal 14—The last sentence of § 33.57(b) as proposed is amended to require the engine "or" its parts to be subjected to additional tests if required instead of the engine "and" its parts.

As discussed in connection with Proposal 1 of Part 21, new § 33.62 is added to require stress analysis of certain engine parts.

Proposal 15—A commentator recommended revision of proposed § 33.65 to include reference to the allowable engine operating limitations in order to clarify that there could not be a finding of noncompliance if any of the undesired effects resulted from operations beyond those limitations. The section is intended to apply only to operations that are within allowable operating limitations as set forth in the manufacturer's operating instructions and the requirement is revised to make this clear.

In addition, the section is revised to delete the reference to inlet air distortion caused by cross-wind, which is adequately covered by the manufacturer's specification of limiting inlet air distortion, and to ice ingestion, which is adequately covered by other requirements.

Proposal 16—Several commentators recommended that § 33.66 be clarified to avoid the interpretation that a reduction in engine performance due to bleed air would be an "adverse effect on the engine." To preclude this possible misinterpretation, the section is revised accordingly.

Proposal 17—Several commentators suggested that paragraph (a) of § 33.67 be revised to allow for the use of seals and locking devices as alternatives to making the fuel control adjusting means inaccessible. The FAA agrees that these alternative means be used to achieve the desired intent and the section is revised accordingly.

Several commentators expressed doubt that it should be necessary to add any water to saturated fuel since upon cooling the saturated water would precipitate out, thus representing the most critical condition. The FAA does not agree that the amount of water which may precipitate out properly represents the most critical amount of free water possible in the system. The added water is necessary to simulate critical conditions.

Several commentators expressed doubt that § 33.67(b)(6) could be literally complied with and suggested that the aim of the rule was that all means be taken to prevent the release of contaminants, and that an insignificant amount of contaminant release should not violate the rule. The FAA agrees with this comment and the rule as adopted requires design of the bypass to minimize release of contaminants.

Other revisions to the section have been made for the reasons set forth in the discussion relating to § 23.997, which contains like requirements.

Proposal 18—The comments received in response to proposed § 33.68 were similar to those received in connection with the substantively similar provisions contained in Proposal 6 of Part 23, § 23.1093. The section is revised in accordance with the discussion pertaining to revisions of that section.

Proposal 19—Several commentators objected to the requirement in § 33.69 for two igniters; however, this is the requirement of the present rule and the only proposed change to the rule is the requirement for a single igniter for fuel augmentation systems. No objections were received to this provision.

Proposal 20—Several commentators objected to the requirement in § 33.71(b)(6) for cockpit indication of oil filter contamination, where no bypass is incorporated. However, the FAA considers the addition of a cockpit indicator to be necessary in the interest of safety in order to enable the flight crew to prevent engine failure due to oil starvation, that might occur if all required filters in the lubrication system do not incorporate the protection of a filter bypass.

As indicated by other commentators, the words "extreme temperature" as used in proposed § 33.71(c)(9) could be taken to require compliance at temperatures beyond the intended operating range. Such a result would be contrary to the intent of the requirement and the section as adopted is revised to refer to maximum operating temperature. In response to other comments the differential pressure requirement in subparagraph (c)(9) is reworded to clarify that it may not be less than 5 p.s.i. above the maximum operating pressure of the tank.

One commentator considered that the lack of a requirement for a bypass was a serious deficiency in the proposal. The FAA has considered this question many times including extensive discussion at government-industry airworthiness meetings and has determined that due to the serious divergence of opinion the use of a bypass should at present be optional. If no bypass is used, however, the applicant must comply with other safeguards contained in the section to ensure safe operation of the lubrication system.

The remainder of the comments were similar to those made in response to Proposals 3, 4, and 5 of Part 23 and have been responded to in discussion of those proposals. The section has been reworded in part to conform with the changes made to the sections involved in those proposals.

Proposal 21—One commentator recommended that § 33.72 should refer to a "main" filter only. The FAA does not agree; the requirements are meant to apply to each filter or screen incorporated in the system.

Proposal 22—Several commentators believed that § 33.75 as written was confusing and ambiguous. The printed notice was incorrectly worded and the section is rewritten to read correctly.

Several commentators suggested that the word "burst" in subparagraph (b) was ambiguous and needed further definition. The FAA agrees and, accordingly, a further descriptive phrase, "penetrate its case," is added.

One commentator suggested that the phrase "improper operations" be substituted for "bad operation". The FAA agrees with the suggestion and the section incorporates this change.

One commentator objected to consideration of multiple failures, to avoid consideration of an infinite number of possible failures. The analysis however does not require that all possible multiple failures be considered, but uses the accepted standard of consideration of only the probable single or multiple failures.

Proposal 23—One commentator suggested that § 33.77(a)(2) be clarified to ensure that a burst meant uncontained burst that penetrates the case. The FAA agrees that this is the intent of the section and it is revised accordingly.

Several commenators suggested that the footnote to the table be modified to permit the option of demonstrating containment on a component basis for all the test items. The FAA does not agree that this would adequately account for secondary effects except in the case of blade containment in fan engines as noted.

Several commentators expressed doubt that the proposed rate of ingestion of 1½ pound birds was supported by ornithological data or actual flight experience. They suggested that a lesser rate be used. The FAA, after further study and consideration, agrees. Accordingly, the ingestion rate of 1½ pound birds is established at one for the first 300 square inches of inlet area and at one for each 600 additional square inches or fraction thereof, of up to a maximum of 8 birds.

The practical reality of a 4-inch hailstone was questioned in some of the comments. The FAA, after further study, has determined that this size will probably not be encountered in actual flight conditions and the section is amended to delete the requirement.

Several commentators believed that the amount of sand and gravel specified was excessive and not representative of actual conditions. After further consideration, the FAA agrees that the amount proposed should be reduced and the section is revised accordingly.

The FAA agrees with the point raised by several commentators that, in § 33.77(c), some power or thrust loss should be permitted since the ingestion of these objects will certainly cause a temporary power loss. Accordingly, the requirement is revised to permit power or thrust loss that is not "sustained." In addition, § 33.77(f) is revised, upon further consideration, to require testing of water ingestion to take place under takeoff operating conditions rather than the proposed "maximum cruise." This reflects current practice in engine certification.

The ¼ by 1 inch bolt test is deleted since the test for the broken rotor blade is a more stringent test and will adequately account for the effects of the bolt.

A comment was received that objected to the provision in proposed § 33.77(d)(3) relating to obstruction of induction airflow by foreign objects that are stopped by a protective device. The FAA wishes to point out that the subject provision does not state a requirement that must be met by all applicants. Rather, it provides an alternative to testing for the effects of objects that can be stopped by a protective device and prevented, by deflection out of the airflow path or by some other means, from obstructing the induction airflow in any way.

In addition, a new paragraph (e) is included in § 33.77 to incorporate the suggestion offered by some commentators that the effects of ingestion of some foreign objects can be accounted for by the effects of others. Thus, in showing compliance with § 33.77 (a) the applicant is required to test only for that object that is shown to have the most severe effect. Similarly, for compliance with (b), testing is required for sand and gravel and either the 3 ounce or 1½ pound birds, depending on the size of the engine inlet, as designated in § 33.77(f).

Proposed paragraph (e) is redesignated as paragraph (f).

Proposal 24—One commentator recommended that in § 33.79(a) an acceptable means of compliance to demonstrate cooling be provided for the guidance of the applicant. The FAA, upon further consideration agrees that the section does not adequately establish a definable objective and the proposal is withdrawn for further study. Proposed paragraphs (b) through (f) are redesignated (a) through (e), respectively.

One commentator believed that paragraph (e) of the proposed rule could be misinterpreted as allowing a loss of thrust to the unaugmented engine in an amount equal to that added by the augmentor. To avoid possible misinterpretation, the requirement, adopted in § 33.79(d), is reworded to clarify that the loss of thrust mentioned means only the thrust that is provided by augmentation. Furthermore, upon further consideration, the FAA has revised the requirement to refer only to failure or malfunction of augmentor combustion, since the effects of other possible augmentor failures on engine thrust cannot be reliably predicted.

One commentator recommended clarification of proposed paragraph (f) to ensure that the rotational speed mentioned be the minimum rotational speed at which the thrust augmentation functions. This is the original intent of the paragraph and it is modified accordingly.

Proposal 25—One commentator pointed out an error in th eexplanation of proposed changes to § 33.81. Instead of referring to § 33.43, it should have referred to § 33.87. No change to the adopted rule itself is necessary, however.

Proposal 26—No comments were received on the proposed new § 33.82, and the section is adopted as proposed.

Proposal 27—Several commentators recommended that the requirement in § 33.83 for testing to 110 percent of the desired maximum continuous speed rating be deleted because certain high performance turbine engines may not be capable of achieving this overspeed condition. Upon further consideration, the FAA agrees with the commentators' position and the requirement is deleted.

Other revisions to the section have been made for the reasons set forth in the discussion relating to § 33.43, which contains like requirements.

Proposal 28—Revisions have been made to § 33.85 for the reasons set forth in the discussion relating to § 33.45, which contains like requirements.

Proposal 29—Several commentators requested that the surface temperature requirement be deleted from proposed § 33.87(a)(3) as being difficult to simulate on a test stand. The section is intended by the FAA to require that if an engine external temperature limit be specified by the applicant as being critical, then the applicant must demonstrate satisfactory operation at that temperature. It is pointed out that only those temperatures specified by the applicant need be held at their specified values and the requirement is reworded to clarify this. In addition, the section is revised to provide allowance for more than one test run if all parameters cannot be held at the required values simultaneously.

Several commentators objected to subparagraph (a)(4) of § 33.87 which had called for fuels, lubricants, and hydraulic fluids with the lowest thermal breakdown temperatures allowed by their specifications to be used during the tests . They felt that this was practically an impossible requirement because of the unavailability of fluids and lubricants with all the minimum properties called for. The FAA agrees, and the requirement is revised to call for specified fluids and lubricants used during the endurance tests to conform to their respective specifications.

One commentator suggested that § 33.87(a)(6) be amended to require that only shear and overload loads be tested and that the requirement for other loading during the endurance tests be deleted. The FAA does not agree, but intended that the endurance test simulate actual operation and include testing of the accessories drives themselves as well as other portions of the engine. This requires loading of those drives, and the rule is adopted as proposed.

Several commentators questioned whether the limit load for accessories specified in subparagraph (a)(6) should apply only during maximum power operation. This is the intended construction of the section, and it is amended to reflect this intent.

One commentator expressed concern that compliance with § 33.87(a)(8) which calls for cooling air simulation could not be demonstrated since in a particular engine there may be many divisions of cooling air-flow which might make it virtually impossible to individually regulate each separate cooling airflow path. The FAA agrees with the commentator's position and the proposal is withdrawn for further study.

Several commentators suggested that the references to supersonic engines be deleted because of the lack of foreseeable need for such engines. The FAA does not agree. One of the purposes in formulating these new amendments is to establish standards for that new generation of engines, especially since the FAA is in the process of presently certificating such engines.

One commentator pointed out that the proposal did not include the false start tests of the present rule. This was an inadvertent omission and those false start tests are included in the adopted rule.

Proposal 30—The phrase "for installation in an engine" is deleted from § 33.88 as being surplusage.

Proposal 31—One commentator requested that a better definition be used in § 33.89 (b) for the term "extreme ambient temperature and altitude." The FAA agrees that, taken literally, the requirement could be unnecessarily burdensome. Accordingly, the wording is modified to read "maximum and minimum operating ambient temperature" and "maximum operating altitude." In addition, upon further consideration, the last sentence of the proposed requirement is deleted as unnecessary.

Proposal 32—One commentator believed that for the overhaul test of § 33.90 two starts per hour was unnecessarily severe and suggested that a number representative of intended operation might be substituted for the stated requirement. The FAA agrees that if the applicant could show that a lesser number of starts would be more representative of intended operation for the particular engine that this would adequately comply with the intent of the section, and the section is revised accordingly. Furthermore, since this revision eliminates the distinction in the section between airplane and rotorcraft engines, the requirement is expressed in a single paragraph, rather than in (a) and (b) as proposed.

In response to several comments, § 33.90 as adopted is revised to clarify that the requirement applies only to engines being originally type certificated; it does not apply to engines being certificated through amendments to existing type certificates or through supplemental type certification procedures.

Several commentators recommended deleting the entire section as proposed. They expressed the opinion that it was unreasonable to require the completion of an overhaul test in addition to the endurance test as a condition of type certification and believed that past practices were adequate to establish an initial overhaul period. One commentator stated that the 150 hour endurance test, because of its accelerated nature, should be equivalent to a 1000 hour overhaul period. The FAA does not agree. This additional overhaul test is necessary since experience on certain engines has shown that the endurance test has not been equivalent to longer service operations, especially for periods as long as 1000 hours.

Proposal 33—Several commentators pointed out that the oil tank requirement in paragraph (c) of proposed § 33.91 was redundant with a similar proposed requirement in proposed § 33.71(c)(9). The specified test requirements for oil tanks are covered under § 33.71(c)(9) and reference to oil tanks is, therefore, not included in § 33.91(c) as adopted. References to "extreme temperature" and "the sum of 5 p.s.i. and the maximum operating pressure" in the requirements specified in § 33.91(c) have been revised for reasons discussed in connection with Proposal 20, this Part (§ 33.71). In addition, and for the same reason, references to "extreme temperature" in § 33.91(d) have been replaced by "maximum and minimum operating temperature", and the requirement to test while cycling operating conditions from "one extreme to another" has been rewritten to require cycling between maximum and minimum operating conditions.

Proposal 34—Several commentators expressed the opinion that the tests required under § 33.92 are unnecessary for engines that are to be used in single engine aircraft. One commentator further suggested that the time period of 3 hours may not be appropriate to a practical situation but rather, the time period and r.p.m. should be based upon the conditions arising from a recommended flight technique following an engine failure at a critical point in the flight path. Another commentator expressed doubt that windmilling for 3 hours without oil was a normal expectancy. The FAA does not agree. It is not possible, at the time of certification, to know the end use or particular intended flight conditions for each engine. It is therefore necessary to establish a general criterion which will adequately demonstrate a degree of safety for conditions that a turbine engine would likely encounter on a typical and usual route structure. The 3 hour time period specified does represent a time period representative of an expected route structure and windmilling for 3 hours without oil is a reasonable possibility.

One commentator recommended that the proposed rule be clarified to specifically allow for the engine windmilling speed to either decrease or stop due to freezing of bearings. The proposal as written does not specifically mention this condition. However, the FAA agrees that this would be a satisfactory means of accomplishing the intent of the section and the rule is revised to allow for this condition.

One commentator recommended deletion of the entire section because he believed there was insufficient experience pointing out a need for these tests and because the proposal implies a flight test as a condition of engine certification. The FAA finds that experience establishes the need for these tests and points out that flight tests are not specifically required by the rule.

Proposal 35—The changes to § 33.93 are similar to those made for § 33.55, which was the subject of similar comments. The changes and comments are discussed in connection with Proposal 13, this Part.

Proposal 36—The changes to § 33.99 are similar to those made for § 33.57, which was the subject of similar comments. The changes and comments are discussed in connection with Proposal 14, this Part.

Finally, it should be noted that a number of the rule changes contained in this amendment deal with subjects for which proposals were received for inclusion in the 1974–75 Airworthiness Review Program (Notice 74-5; 39 F.R. 5785). As indicated in that Notice and in Notice 74-5A (39 F.R. 18662), inviting comment on the proposals received, rule making procedures separate from the Airworthiness Review could result in removal of proposals from further consideration during the Airworthiness Review Program. The FAA has determined that the following FAA proposals presently being processed in the 1974–75 Airworthiness Review relate to issues that are covered by the rules adopted by these amendments, and need not, and will not, be given further consideration during the 1974–75 Airworthiness Review:

Proposal No.	*FAR'S*	*Subject*
677 (with respect to proposed paragraph (q) only)	§ 23.1305	Powerplant instruments
752	§ 25.997	Fuel strainer or filter
784	§ 25.1305	Powerplant instruments
863	§ 27.1305	Powerplant instruments
941	§ 29.1183	Lines and fittings
947	§ 29.1305	Powerplant instruments

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, Parts 1, 21, 23, 25, 27, 29, and 33 of the Federal Aviation Regulations are amended as follows, effective October 31, 1974.

Amendment 25–37

Form Number and Clarifying Revisions

Adopted: December 31, 1974 **Effective: February 14, 1975**

(Published in 40 F.R. 2576, January 14, 1975)

The purpose of these amendments is to incorporate into Parts 21, 23, and 25 of the Federal Aviation Regulations several form number and clarifying revisions.

These amendments are based on a Notice of Proposed Rule Making (Notice No. 74–33) published in the Federal Register on October 11, 1974 (39 F.R. 36595) and are the first amendments issued as a part of the First Biennial Airworthiness Review Program (ref. Notice No. 74–5, 39 F.R. 5785). These amendments and the reasons therefor are the same as those proposed in Notice No. 74–33.

Interested persons have been afforded an opportunity to participate in the making of these amendments. No objections were received.

These amendments are made under the authority of sections 313(a), 601, 603, and 608 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, and 1428), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, and for the reasons stated in Notice No. 74–33, Parts 21, 23, and 25 of the Federal Aviation Regulations are amended effective February 14, 1975.

Amendment 25-38

Airworthiness Review Program

Amendment No. 3: Miscellaneous Amendments

Adopted: December 13, 1976 **Effective: February 1, 1977**

(Published in 41 FR 55454, December 20, 1976)

The purpose of these amendments is to update and improve—(1) the aircraft, engine, and propeller certification regulations; (2) the operating regulations containing airworthiness standards; and (3) related procedural requirements.

These amendments are based on a notice of proposed rule making (Notice 75-10) published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802) and are the third in a series of amendments to be issued as part of the First Biennial Airworthiness Review Program. The following series of amendments have previously been issued as part of this Airworthiness Review Program:

Title	*Federal Register citation*
Form number and clarifying revisions	(40 F.R. 2576; Jan. 14, 1975)
Rotorcraft anticollision light standards	(41 F.R. 5290; Feb. 5, 1976)

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon the relevant comments received and upon further review within the FAA. Except for the minor editorial and clarifying changes and the substantive changes discussed hereinafter, these amendments and the reasons therefore are the same as those contained in Notice 75-10.

After issuing Notice 75-10, the following six additional notices of proposed rule making were issued as part of the First Biennial Airworthiness Review Program.

Notice No.	*Federal Register citation*	*Title*
75-19	40 F.R. 21866; May 19, 1975.	Notice No. 3: Powerplant Proposals.
75-20	40 F.R. 22110; May 20, 1975.	Notice No. 4: Equipment Deviation List.
75-23	40 F.R. 23048; May 27, 1975.	Notice No. 5: Equipment and Systems Proposals.
75-25	40 F.R. 24664; June 9, 1975.	Notice No. 6: Flight Proposals.
75-26	40 F.R. 24802; June 10, 1975.	Notice No. 7: Airframe Proposals.
75-31	40 F.R. 29410; July 11, 1975	Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals.

Based upon further review by the FAA, a number of proposals which were contained in Notice 75-10 are not being dealt with herein but will be considered in conjunction with other proposals contained in one of the later Airworthiness Review Program Notices of proposed rule making.

The following discussion is keyed to the like-numbered proposals contained in Notice 75-10:

Proposal 2-1. One commentator suggested that the proposed change to § 21.33(a) be revised to limit the new aircraft engine and propeller inspection and test provisions to prototypes only. The FAA does not agree. The intent of the proposals was to make the inspection and test requirements in § 21.33(a) compatible for aircraft, aircraft engines, and propellers. The provision applies to the item presented for type certification tests irrespective of whether or not the item is considered a prototype by the applicant for the type certificate. The proposal is therefore, adopted without substantive change.

Proposal 2-2. No unfavorable comments were received on the proposal to amend § 23.23. Accordingly, the proposal is adopted without substantive change.

Proposal 2-3. No unfavorable comments were received on the proposal to amend § 23.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2-4. No unfavorable comments were received on the proposal to amend § 23.143(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-5. No unfavorable comments were received on the proposal to amend § 23.145. Accordingly, the proposal is adopted without substantive change.

Proposal 2-6. The proposed change to § 23.149(b) concerning the language "without exceptional piloting skill, alertness, or strength" is related to a proposed amendment to § 23.149 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.149(b) contained in Notice No. 2 is therefore being deferred until final rule making action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-6 will be considered at that time.

Proposal 2-7. Although no unfavorable comment was received on the proposal to amend § 23.175(c), the FAA believes that clarification is necessary. The term "or thrust" has been added to the end of the language "maximum cruising power" in proposed § 23.175(c)(3). Proposed § 23.175(c)(4) was intended to clarify the requirement concerning trim speed, but the FAA believes the conflict in language with a similar provision in § 23.175(b)(2)(iii) may cause confusion. Therefore, proposed § 23.175(c)(4) is withdrawn.

Proposal 2-8. The proposed change to § 23.253(b) is related to a proposed amendment to § 23.253(b)(3) that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410 July 11, 1975). The proposed amendment to § 23.253(b) contained in Notice No. 2 is therefore being deferred until final rule making action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-8 will be considered at that time.

Proposal 2-9. No unfavorable comments were received on the proposal to amend § 23.397. Accordingly, the proposal is adopted without substantive change.

Proposal 2-10. No unfavorable comments were received on the proposal to add a new § 23.479(d). Accordingly, the proposal is adopted without substantive change.

Proposal 2-11. One commentator objected to the proposed use of the language "materials used for parts, the failure of which could adversely affect safety" in place of the language "materials used in the structure" in §§ 23.603(a) and 25.603. The FAA does not agree with the commentator's suggestion that all parts of the airplane should, unless specifically excluded, be considered structure. The FAA believes that consideration of the suitability and durability of materials used should be broadened to include parts not normally considered airplane structure.

Proposal 2-12. No unfavorable comments were received on the proposal to amend § 23.607. Accordingly, the proposal is adopted without substantive change.

Proposal 2-13. A commentator questioned whether proposed § 23.675 would require that stops provided to limit the range of motion of an aerodynamic surface be located only on the aerodynamic surface or whether the stop could be located adjacent to the surface. Section 23.675, as proposed and as adopted herein, without change, requires that stops positively limit the range of motion of moveable aerodynamic surfaces. This can be accomplished by locating the stop on structure adjacent to the surface.

Proposal 2-14. No unfavorable comments were received on the proposal to amend § 23.685(a). Accordingly, the proposal is adopted without substantive change. See proposal 2-109.

Proposal 2-15. No unfavorable comments were received on the proposal to add a new § 23.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-16. No unfavorable comments were received on the proposed new § 23.787(f). However, one commentator pointed out that the word "contract" in the proposal as printed in the Federal Register should be "contact." The proposal has been corrected to eliminate the printing error. The proposal has also been clarified based on a comment received on Proposal 2-111, to avoid any implication that lamps will be required in cargo compartments.

Proposal 2-17. One commentator questioned the need in proposed § 23.841(b)(6) for a warning indicator at the pilot station to indicate when a cabin pressure altitude of 10,000 feet is exceeded. But as noted by the commentator it is a general industry practice to provide this warning at a cabin altitude of 10,000 feet. The FAA believes that due to the larger number of small airsplanes having such a warning many pilots may come to rely on the warning at this cabin altitude. The proposal is therefore adopted without substantive change.

Proposal 2-18. The proposed changes to §§ 23.853, 27.853, and 29.853 concerning the certification requirements necessary to permit smoking in certain aircraft categories are related to proposed standards for § 25.853. The amendments proposed for § 25.853 are contained in Airworthiness Review Program Notice No. 2: Miscellaneous Proposals (Notice 75-10; 40 FR 10802; March 7, 1975) and in Airworthiness Review Program Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410; July 11, 1975). The proposals for § 25.853 in Notice 75-10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. The proposed amendments to §§ 23.853, 27.853 and 29.853 contained in Notice 75-10 are therefore being deferred until final rulemaking action is taken with respect to the related proposal for § 25.853. Comments submitted for Proposals 2-18, 2-114, and 2-160 will be considered at that time.

Proposal 2-19. One commentator suggested a clarification of proposed new § 23.903(b) noting that the language, "must be designed to give reasonable assurance" would be subject to divergent application. The same language is now used in § 25.903(d)(2), and the FAA believes that experience with this provision in transport category type certification has been satisfactory.

One commentator suggested that a provision similar to § 25.903(d)(1) concerning design precautions to minimize hazards to the airplane in the event of an engine rotor failure be included in proposed §§ 23.903(b), 27.903(c), and 29.903(f). Although several airworthiness directives have been issued to prevent the failure of engine rotors in one engine type, the FAA does not believe that a general requirement for §§ 23.903(b), 27.903(c), or 29.903(f) that is identical to § 25.903(d)(1) is necessary at this time.

Proposal 2-20. No unfavorable comments were received on the proposal to amend § 23.933(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-21. One commentator objected to proposed new § 23.941 concerning airplanes with variable inlet or exhaust system geometry as being unnecessary and unjustified in Part 23. The FAA agrees that this provision should not be added to Part 23 at this time and is therefore withdrawing the proposal.

Proposal 2-22. One commentator suggested that the proposed changes to §§ 23.971 and 23.999 be revised to require a quick actuation drain valve on each fuel tank. The proposal, however, was not to require new drainage outlets but to establish standards for the drains set forth in proposed § 23.971(b) and present § 23.999(a). The FAA does not have sufficient information to indicate that a need exists for a quick actuation drain valve on each fuel tank considering the large number of different types of fuel tanks which are included on Part 23 airplanes and the use of sediment bowls and chambers. The proposal is therefore adopted without substantive change.

Proposal 2-23. One commentator question the proposed requirement in § 23.977 (a)(2) that a turbine engine fuel strainer prevent the passage of any object that could restrict fuel flow or damage any fuel system component. The commentator asserted that a strainer which met this requirement would have an opening so small that ice accumulation with the use of turbine fuels would be a problem. The FAA does not agree. This is identical to the provision in § 25.977(a)(2). Experience with fuel strainers that would meet the proposed standards in § 23.977(a)(2) has shown that a strainer can prevent the passage of the noted objects and also prevent ice accumulation.

One commentator noted that the clear area of each fuel tank outlet strainer should be at least six times the area of the outlet line instead of five times as proposed in § 23.977(b). This provision is identical to § 25.977(c) and the FAA considers that experience with this requirement in Part 25 has been satisfactory.

Proposal 2–24. The intent of the proposal to add a new § 23.979(e) was to provide strength requirements including load factors, applicable to the airplane defueling system to cover surge pressure during defueling. Upon further review the FAA believes that the proposed amendment is premature. Therefore, the proposal is withdrawn.

Proposal 2–25. No unfavorable comments were received on the proposal to amend § 23.995(d). Accordingly, the proposal is adopted without substantive change.

Proposal 2–26. One commentator suggested that there should be sufficient clearance between the quick actuation drain and other parts of the airplane to allow the fuel sample to be drained into a typical, small container. The FAA believes fuel system drains which meet the proposed requirements of paragraphs(b)(1) and (b)(3) of § 23.999, that the drain discharge clear of all parts of the airplane and that it be readily accessible, will have sufficient clearance to allow a fuel sample to be drained into a small container.

One commentator suggested that the requirement in § 23.999(b)(1)) that the drain must discharge clear of all parts of the airplane, would create unnecessary design and construction restraints. The FAA believes that by coating some airplane surfaces with fuel or by trapping quantities of fuel in certain locations a fire hazard exists. This fire hazard should be limited by this proposal. Further, the FAA believes this requirement can be met without an undue restraint on airplane design.

A commentator asserted that the proposed requirement in § 23.999(b)(3), that the drain valve be either located or protected so that it will not be damaged in the event of a landing with landing gear retracted cannot be justified. The commentator noted that the fuel tanks would be ruptured in such a landing and nothing would be gained if the drain was protected. The FAA disagrees, similar fuel tank installation requirements are set forth in § 23.967 and experience indicates that the fuel system can and should be either located or protected to prevent fuel leakage in such a landing. The FAA does agree that the proposal needs to be clarified to more specifically provide a design specification and has, so modified paragraph (b)(3). Also see Proposal 2–70.

Proposal 2–27. No unfavorable comments were received on the proposal to add a new § 23.1093(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–28. Proposed § 23.1111(c) was misunderstood by one commentator who asserted that it is not possible to assure the impossibility of failure of the engine lubricating system. The proposal, however, was directed toward the elimination of hazardous contamination of the cabin air assuming a failure of the engine lubricating system. In consideration of the misunderstanding, the language has been revised to emphasize the prevention of hazardous contamination of cabin air system.

Proposal 2–29. Although no unfavorable comment was received on the proposed § 23.1125, the FAA believes that the proposal could misunderstood as to whether use of the heat exchanger would permit or prohibit the passage of exhaust gases through the exchanger when hot air was not being directed to the area where it was intended to be used. The FAA's intention was to require cooling of the exchanger wherever it was in contact with exhaust gases, regardless of its usage status. The proposal is revised to make this clear using the language of §§ 25.1125(a)(3) and 29.1125(a)(3). The FAA believes that the exhaust heat exchange requirements should be paralleled in Parts 23, 25 and 29. Therefore the proposed changes to §§ 25.1125(a)(3) and 29.1125(a)(3) are withdrawn.

Proposal 2–30. No unfavorable comments were received on the proposal to amend § 23.1143. Accordingly, the proposal is adopted without substantive change.

Proposal 2–31. One commentator believed that proposed § 23.1165(e) was unnecessarily restrictive in requiring all ignition systems to be independent of all other electrical systems. The FAA agrees with respect to reciprocating engines since § 33.37 requires a dual ignition system or an ignition system of equivalent inflight reliability for reciprocating engines and § 23.903 requires each engine installed on small airplanes to be type certificated under Part 33. However, the FAA disagrees with respect to turbine engines since two separate primary electrical circuits are not required in § 33.69. The rule as adopted is applicable to turbine engines installed on small airplanes only.

Proposal 2–32. One commentator objected to the proposal to add a speed warning device for turbopropeller powered airplanes. The FAA believes that due to the characteristics of turbopropeller powered airplanes that make it desirable to operate at the maximum operating limit speed (V_{MO}/M_{MO}), and the increasing preoccupation of pilots with air traffic and other duties which distract them from continuous monitoring of airspeed instruments overspeed conditions can be a problem. Therefore, to insure early warning and thus to make a major portion of the speed margin available for pilot reaction and recovery maneuvers, the amendment requires that the speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots whenever the speed exceeds V_{MO} plus 6 knots or $M_{MO}+0.01$.

It should also be noted that the proposal for § 23.1303(d) has been revised to make it like § 25.1303(a)(1) to allow for an air temperature indicator which provides indications that are convertible to free-air temperature.

Proposal 2–33. No unfavorable comments were received on the proposal to amend § 23.1309. Accordingly, the proposal is adopted without substantive change.

Proposal 2–34. One commentator suggested that proposed §§ 23.1322 and 25.1322 concerning warning, caution, and advisory light be revised. The commentator noted that requiring a blue light for position indication was not always appropriate since blue was difficult to see in direct sunlight but was readily distinguishable in heavily shaded installations. The FAA agrees that blue should not be an established standard applicable to all installations. Therefore proposed §§ 23.1322(d), 25.1322(d), 27.1322(d) and 29.1322(d), concerning blue lights, are withdrawn. Also see Proposal 2–82.

Proposal 2–35. The proposed amendments to §§ 23.1325, 25.1325, and 29.1325 concerning the static pressure sources are related to proposed amendments to § 27.1325 that are contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75–10; 40 FR 10812; March 7, 1975) and in Airworthiness Review Program, Notice No. 5: Equipment and System Proposals (Notice 75–23; 40 FR 23048; May 27, 1975). The proposed amendment to § 27.1325 in Notice 75–10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. The proposed amendments to §§ 23.1325, 25.1325, and 29.1325 contained in Notice 75–10 are therefore being deferred until final rulemaking action is taken with respect to the related proposed amendments to § 27.1325. Comments submitted for Proposals 2–35, 2–83, and 2–183 will be considered at that time.

Proposal 2–36. One commentator questioned the proposed lead-in for § 23.1331(b). The commentator interpreted the proposal to mean that each instrument must have independent power sources and noted that the explanation did not indicate this to be intended. The FAA agrees that the proposal is not clear, and the proposal is withdrawn.

Proposal 2–37. The proposed change to § 23.1335 concerning the deletion of the section is related to a proposed amendment to § 23.1335 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75–23; 40 FR 23048; May 27, 1975). The proposed amendment to § 23.1335 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. Comments submitted for Proposal 2–37 will be considered at that time.

Proposal 2–38. No unfavorable comments were received on the proposal to amend § 23.1351. Accordingly, the proposal is adopted without substantive change.

Proposal 2–39. Proposed § 23.1353(f) concerning nickel-cadmium batteries is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1353 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–39 will be considered at that time.

Proposal 2-40. For comments related to the proposed amendment of § 23.1385, see Proposal 2-89.

Proposal 2-41. One commentator suggested that proposed § 23.1411(b)(2) be revised to conform to the language in § 25.1411(b)(2). The FAA, however, believes a more specific standard is appropriate for §§ 23.1411 and 27.1411. Therefore, the proposed amendments to §§ 23.1411 and 27.1411 are adopted without substantive change.

Proposal 2-42. One commentator suggested that the proposed change to § 23.1549 be revised to accommodate horizontal scale powerplant instruments. The FAA agrees, and §§ 23.1549, 27.1549 and 29.1549, as adopted, will provide marking standards appropriate to circular, horizontal and vertical scale powerplant instruments.

Proposal 2-43. The proposed change to § 23.1555 concerning the information requirements of usable fuel in a restricted use fuel tank is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1555 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-43 will be considered at that time.

Proposal 2-44. The proposed change to § 23.1557 concerning the system voltage marking requirement adjacent to its external power connection is related to a proposed amendment to § 23.1557 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 23.1557 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2-44 will be considered at that time.

Proposal 2-45. The proposed change to § 23.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related Proposal in Notice 75-25. Comments submitted for Proposal 2-45 will be considered at that time.

Proposal 2-46. The proposed change to § 23.1587(a)(2) is related to proposed amendments to § 23.1587 that were contained in Airworthiness Review Program, Notice 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-46 will be considered at that time.

Proposal 2-47. One commentator suggested that considering the proposed deletion of §§ 25.45 through 25.75, current § 25.161(e) will need to be amended to replace the reference to § 25.69. The FAA agrees, and § 25.161(e)(1) is amended by striking the reference to § 25.69 and inserting in place thereof a reference to § 25.123(a). In addition, the FAA has found that § 25.201(c)(1) refers to § 25.49(c)(2)(i) that would also be deleted. Therefore, § 25.201(c)(1) as amended strikes the phrase "§ 25.49(c)(2)(i) for reciprocating engine powered airplanes, or in" and the phrase "for turbine engine powered airplanes".

Proposal 2-48. No unfavorable comments were received on the proposed change to strike the words "turbine powered" from § 25.101(a). Accordingly, proposed § 25.101(a) is adopted without substantive change.

No unfavorable comments were received on proposed § 25.101(b) and it is adopted as proposed except that it is clarified to indicate that the 80% relative humidity for reciprocating engines is based on standard atmospheric temperature (the vapor pressure values in the table in proposed § 25.101(b)(2) correspond to 80% relative humidity with a standard atmosphere).

Proposal 2-49. Based on comments reveived on the proposal to amend § 25.105 and on the related proposals to §§ 25.125, 25.241 and 25.1533(c), and upon further review by the FAA, Proposals 2-49, 2-51, 2-52 and the portion of 2-93 dealing with the new operating limitation requirements for transport category airplanes intended to be used in operations on unpaved runways are withdrawn.

Proposal 2-50. No unfavorable comments were received on the proposal to amend § 25.107. Accordingly, the proposal is adopted without substantive change.

Proposal 2-51. For comments related to the withdrawal of the proposed amendment of § 25.125, see Proposal 2-49.

Proposal 2-52. For comments related to the withdrawal of the proposal to add a new § 25.241, see Proposal 2-49.

Proposal 2-53. No unfavorable comments were received on the proposal to amend § 25.397. Accordingly, the proposal is adopted without substantive change.

Proposal 2-54. For comments related to the proposed amendment of the lead-in of § 25.603, see Proposal 2-11.

Proposal 2-55. No unfavorable comments were received on the proposal to amend § 25.675. Accordingly, the proposal is adopted without substantive change. Also see Proposal 2-13.

Proposal 2-56. No unfavorable comments were received on the proposal to amend § 25.685(a). Accordingly, the proposal is adopted without substantive change. See Proposal 2-109.

Proposal 2-57. No unfavorable comments were received on the proposal to add a new § 25.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-58. One commentator questioned whether the proposed § 25.775(e) would require that there be at least two windshield panels in the windshield for each pilot. The intent of the proposal, however, is to provide at least one windshield panel through which at least one pilot could see if vision was lost through another panel.

Proposal 2-59. Proposed § 25.783(g) concerning integral stairs installed in passenger entry doors that qualify as passenger exits is related to a proposed amendment to § 25.783 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.783(g) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-59 will be considered at that time.

Proposal 2-60. The proposed change to § 25.785 is related to a proposed amendment to § 25.785 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75-31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.785 contained in Notice No. 2 is, therefore, being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-60 will be considered at that time.

Proposal 2-61. No unfavorable comments were received on the proposed new § 25.787(c). However, based on a comment received on Proposal 2-111, this proposal has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2-62. Four of the five comments received were in favor of the proposal for § 25.815 that would provide for the approval of an aisle width of less than 12 inches, but not less than 9 inches, in transport airplanes with a passenger seating capacity of 10 or less if the aisle width is substantiated by necessary tests. One commentator requested that the proposal be withdrawn because it would result in a reduction in the margin of passenger safety. The FAA disagrees. Service experience with aircraft certificated with less than a 12 inch aisle width in the past has been satisfactory.

Moreover, the FAA will not certificate transport category aircraft with less than a 12 inch aisle width unless the Administrator finds by necessary test that the narrower aisle is safe.

The proposal is adopted without change.

Proposal 2-63. The proposed change to § 25.831 concerning the temperature and ventilation controls for the crew compartment is related to a proposed amendment to § 25.831 that is contained in Airworthiness Review Program Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048, May 27, 1975). The proposed amendment to § 25.831 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-63 will be considered at that time.

Proposal 2-64. One commentator recommended that proposed § 25.841(b)(1) be revised to make it clear that the pressure relief function may be combined with the regulating valve. The proposal would delete the requirement that one of the pressure relief valves be a pressure regulating valve, but it would still allow such a design. This was specifically covered in Notice 75-10.

One commentator suggested that the language "passenger or crew compartment" in proposed § 25.841(b)(8) be changed to read "occupiable area in the cabin" to ensure that a pressure sensor is located in the lower deck service compartment. The FAA believes the language "occupiable area in the cabin" does not clarify the proposed requirements. The language "passenger and crew compartment" is not limited to the main deck of the airplane, but includes a lower deck service compartment even though this lower deck service compartment may not be occupied during takeoff and landing. For clarification, the parenthetical "(including upper and lower lobe galleys)" has been added to § 25.841(b)(8) as adopted.

Proposal 2-65. The proposed change to § 25.853 concerning the certification requirements necessary to permit smoking in transport category airplanes is related to a proposed amendment to § 25.853 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine and Propeller Airworthiness, and Procedural Proposals (Notice 75-31, 40 FR 29410; July 11, 1975). The proposed amendment to § 25.853 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 2-65 will be considered at that time.

Proposal 2-66. No unfavorable comments were received on the proposal to amend § 25.933(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-67. A commentator suggested that a cross-reference to § 25.143 should be added to proposed § 25.941. The FAA agrees that the pilot strength limits now set forth in § 25.143 should be referenced in § 25.941 in order to define appropriately what constitutes "exceptional strength on the part of the pilot". Accordingly, a paragraph (c) has been added to proposed § 25.941 for that purpose.

Proposal 2-68. Two commentators agreed with the intent of the proposed § 25.951(a) concerning fuel system design and operation of the auxiliary power unit (APU) but requested that it be withdrawn to allow time to review other Part 25 provisions for applicability to APU installations. The FAA does not believe that a further review of Part 25 should in this case, delay completion of this rulemaking action. However, if the FAA determines that the language "auxiliary power unit" should be specifically set forth in other provisions to avoid misinterpretation, the FAA will take action to clarify these provisions.

One commentator stated that the fuel system for an APU operated on the ground would be unnecessarily subject to the same requirement as the engine fuel system. The FAA does not agree that this is necessary. If certain operating conditions are the same for both the engine fuel system and the APU fuel system, the FAA believes that the requirements during such periods should be the same. The proposal is therefore adopted without substantive change.

Proposal 2-69. One commentator suggested that the language "proof and ultimate factors" in the proposal for new paragraphs (d) and (e) of § 25.979 be revised to be consistent with § 25.301. The FAA agrees that the terminology should be consistent and the section as adopted is reworded to use the term ultimate load.

One commentator questioned whether the design criteria for the pressure fueling system was applicable to fuel tanks and fuel tank vents. The proposed amendment to § 25.979 was not intended to apply to fuel tanks and vents. The section as adopted has been revised to make this clear.

Proposal 2-70. Several commentators questioned the meaning of the term "quick actuation drain valve" in proposed § 25.999(b)(3). The FAA agrees that the term may be subject to misinterpretation and that the provision is complete without the words "quick actuation".

One commentator asserted that the proposed requirement in § 25.999(b)(3) that the drain valve not be damaged in the event of a landing with landing gear retracted was not a proper design specification since damage was beyond the control of the manufacturer. The FAA agrees that the language "so that it will not be damaged" is not proper for this requirement, but the FAA believes that the valve, the location of the valve, or both, can be designed to prevent fuel spillage, assuming that a landing is made with the landing gear retracted. The section as adopted has been revised to clarify this intent.

Proposal 2–71. One commentator suggested that proposed § 25.1027(d) be revised to limit the design consideration to sludge or other foreign matter entering the feathering system from the oil tank. The FAA disagrees. Design consideration and flexibility should not be limited to preventing entry of material into the feathering system. All sources of sludge and foreign matter must be considered since the purpose of the regulation is the safe operation of the propeller feathering system. The proposal, therefore is adopted without substantive change.

Proposal 2–72. One commentator suggested that the word "critical" be added before the language "ground, water, and flight operating conditions" in the proposal for § 25.1041, but no reason was given. As noted in the explanation to this proposal, § 25.1041 contains a general cooling requirement, while §§ 25.1043 and 25.1045 are more specific with respect to the type of operating conditions which must be considered during tests. Critical conditions are included in the test requirements of §§ 25.1043 and 25.1045. However, the FAA believes that cooling provisions must be adequate under all ground, water, and flight operating conditions.

Proposal 2–73. No unfavorable comments were received on the proposal to amend § 25.1091(c)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 2–74. One commentator agreed with the proposal for § 25.1093 but suggested that the proposal be changed to agree with the format of the previous paragraphs. The FAA agrees, and the proposal as adopted has been structured the same as the previous paragraphs.

Proposal 2–75. One commentator objected to the proposed lead-in for § 25.1125 that limited the applicability of the section to reciprocating engines. The FAA does not believe that the requirements of this section are applicable to other than reciprocating engine powered airplanes. While some early turbine powered airplanes have had an ejector installation in the exhaust stream to pull cooling air through the nacelle, the FAA does not consider this to be an exhaust heat exchanger within the meaning of the language of § 25.1125. Therefore, the proposed lead-in for § 25.1125 is adopted without substantive change.

Proposed § 25.1125(a)(3) is withdrawn. For a discussion of the withdrawal, see Proposal 2–29.

Proposal 2–76. A commentator stated that the phrase "automatically controlled with relation to the amount of power produced by the engine" in proposed § 25.1143(d) is not appropriate for all fluid injection systems. The FAA agrees that the phrase is not appropriate for certain turbine engine powered airplanes and that further revision of § 25.1143(d) should be considered. Proposed § 25.1143(d) has therefore been withdrawn for further study.

No unfavorable comment was received concerning proposed § 25.1143(e) and this paragraph has been adopted without substantive change.

Proposal 2–77. No unfavorable comments were received on the proposal to add a new § 25.1167. Accordingly, the proposal is adopted without substantive change.

Proposal 2–78. No unfavorable comments were received on the proposal to amend § 25.1197(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–79. One commentator suggested that proposed § 25.1303(a)(2) be revised to clarify the method of clock indication which would be permitted under the regulation. The FAA agrees that the intent of the proposal was only to recognize the development of accurate digital clocks and that the minimum information presented should be the same. Proposed §§ 25.1303(a)(2) and 29.1303(d) as adopted are revised to make this clear.

Proposal 2-80. Several commentators suggested that the proposed change to § 25.1305 be revised to except anti-detonant injection (ADI) systems from the powerplant instrument proposal for fluid augmentation systems. The commentators expressed the opinion that the proposal for § 25.1143(d) concerning automatic controls for fluid injection systems (other than fuel) eliminated the need for a powerplant instrument for the ADI system. The FAA believes that the flight crew should be able to monitor the proper functioning of any fluid system that is used for thrust or power augmentation and the section as adopted is applicable to ADI systems. However, the section has been clarified to ensure application only to fluids systems that are used for thrust or power augmentation.

Proposal 2-81. No unfavorable comments were received on the proposal to amend § 25.1309. Accordingly, the proposal is adopted without substantive change.

Proposal 2-82. One commentator questioned the proposed color standardization of warning, caution, and advisory lights in new § 25.1322. The commentator stated "arbitrary standards for specific light colors cannot always be stated" because of the design objective to minimize red lights that require immediate crew action and of the need to consider past experience, test, crew acceptance, and the specific application. The FAA agrees that considerations other than the need for standardization of light colors may dominate in special circumstances, and the section as adopted provides for approval by the Administrator of light colors that are different than the standard. As stated by the commentator and in the section as adopted, a design objective is to have red warning lights only if a hazard is to be indicated which may require immediate corrective action.

One commentator noted that the language "warning light" is used in other sections of the regulations, such as § 25.812(e)(2), and a hazard which may require immediate corrective action will not be indicated. The FAA does not agree; the light noted in § 25.812(e)(2) should be red in future designs unless otherwise approved by he Administrator. The FAA believes that in other sections, if the language "warning light" is used, it is consistent with proposed new § 25.1322. However, if the language "warning light" is determined to be not generally applicable, later rulemaking action can be instituted.

One commentator suggested a clarification of the lead-in of the proposal to limit its applicability to lights installed in the cockpit as indicated in the explanation to the proposal. The FAA agrees, and the lead-ins of §§ 23.1322, 25.1322, 27.1322, and 29.1322 have been clarified.

Also see Proposal 2-34 for a discussion of the withdrawal of the blue light proposal.

Proposal 2-83. For comments related to the deferral of proposed § 25.1325(g), see Proposal 2-35.

Proposal 2-84. The proposed change to § 25.1329 concerning the redesignation of § 25.1329 as § 25.1311 and the addition of provisions for automatic flight control systems is related to a proposed amendment to § 25.1329 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048, May 27, 1975). The proposed amendment to § 25.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-84 will be considered at that time.

Proposal 2-85. Proposed § 25.1331(a)(2) concerning instruments using a power supply is related to proposed amendments to §§ 25.1331 and 25.1333 that are contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposed amendment to § 25.1331(a)(2) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposals in Notice 75-23. Comments submitted for Proposal 2-85 will be considered at that time.

Proposal 2-86. Proposed § 25.1337(a) concerning auxiliary power unit instrument lines is related to a proposed amendment to § 25.1337(a) that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 25.1337(a) contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2-86 will be considered at that time.

Proposal 2-87. Proposed § 25.1353(c)(5) is related to a proposed amendment to § 25.1585 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1353(c)(5) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-87 will be considered at that time.

Proposal 2-88. No unfavorable comments were received on the proposal to amend § 25.1355(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-89. Several commentators suggested that the list of factors to consider for locating forward and rear position lights in proposed §§ 23.1385, 25.1385, 27.1385, and 29.1385 was incomplete.

Two commentators, also suggested that proposed §§ 23.1385(c) and 25.1385(c) be revised to permit a new position light to be installed on each wing tip. The FAA agrees that further study is necessary to develop factors of general applicability for position lights on all aircraft but that a rear position light as far aft as practical on each wing tip of an airplane is a reasonable alternative location. Accordingly, proposed §§ 23.1385(c) and 25.1385(c) have been revised. The proposals concerning the list of factors to be considered for locating forward and rear position lights in § 25.1385 and paralleled in proposed §§ 23.1385, 27.1385, and 29.1385 are withdrawn. However, the deletion of the passing light requirement from current § 25.1385(e) will be made.

Proposal 2-90. One commentator asserted that proposed new § 25.1403 was an operating requirement, not an airworthiness requirement and therefore was not appropriate for Part 25. Although a similar requirement currently exists in § 121.341(b), the FAA believes that such a requirement should be applicable to all newly certificated transport category airplanes.

Two commentators pointed out that the proposal differs from § 121.341(b) in that the proposal was not limited to the area of the wings that are critical from the standpoint of ice accumulation. The FAA agrees, and the section as adopted has been revised accordingly.

A comment was also received that expressed the belief that under the proposal, illumination or other means of ice detection would not be necessary if the wing was shown to have acceptable ice accumulation characteristics. The FAA does not agree. Unless an operating limitation prohibits operations at night in known or forecast icing conditions, the means set forth are required.

Proposal 2-91. Several commentators said that the proposed change to § 25.1439(b)(2)(ii) concerning standards for masks and eye coverings was premature in view of the current testing being conducted on this type of equipment by the FAA. The FAA agrees that this proposed amendment is premature, and new standards are being considered for a later rulemaking action. The proposed change to § 25.1439(b)(2)(ii) is therefore withdrawn.

No favorable comments were received on the proposal to amend paragraph (a) of § 25.1439. Accordingly, the proposal is adopted without substantive change.

Proposal 2-92. No unfavorable comments were received on the proposal to amend § 25.1515. Accordingly, the proposal is adopted without substantive change.

Proposal 2-93. No unfavorable comments were received on the proposal to amend the heading of § 25.1533 and on the proposal to amend § 25.1533(a). Accordingly, this amendment is adopted without substantive change. For comments related to the withdrawal of the proposed new § 25.1533(c), see Proposal 2-49.

Proposal 2-94. The proposed change to § 25.1549 concerning the marking requirements for powerplant instruments is related to a proposed amendment to § 25.1549 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 25.1549 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2—94 will be considered at that time.

Proposal 2-95. One commentator took exception to the proposed deletion of the requirement for marking fuel and oil tank capacities at the filler openings in § 25.1557(b). The FAA believes this method of providing the usable fuel tank capacity and the oil tank capacity is no longer necessary. The pilot has the fuel quantity gage and the Airplane Flight Manual, and the servicing personnel usually have no interest in the usable fuel tank capacity. The determination of oil level in oil tanks is usually accomplished with the dipstick. Accordingly, the proposal is adopted without substantive change.

Proposal 2-96. The proposed change to § 25.1581 concerning the Airplane Flight Manual is related to proposed amendment § 25.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-96 will be considered at that time.

Proposal 2-97. No unfavorable comments were received on the proposal to amend § 25.1583. Accordingly, the proposal is adopted without substantive change.

Proposal 2-98. The proposed change to § 25.1587 concerning performance information is related to a proposed amendment to § 25.1587 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-98 will be considered at that time.

Proposal 2-99. Two commentators questioned the applicability of proposed § 27.25(c) concerning a total weight that was greater than the maximum weight established under § 27.25(a) and noted that a clarification of the applicable flight requirements was needed. The FAA agrees that proposed § 27.25(c) should be clarified. Proposed §§ 27.25(c) and 29.25(c) are intended to provide only a total weight standard for approving the rotorcraft structure for rotorcraft that will be operated under Part 133. Proposed §§ 27.25(c) and 29.25(c) as adopted have been revised to clarify this intent.

Proposal 2-100. Proposed § 27.65(a)(2)(i) concerning climb gradients for rotorcraft other than helicopters is related to a proposed new § 27.1587(b)(3) that is contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75-10; 40 FR 10802; March 7, 1975). The proposed amendment to § 27.1587 contained in Notice 75-10 is being deferred; see Proposal 2-140. Therefore, the proposed amendment to § 27.65 contained in Notice 75-10 is also deferred until final rulemaking action is taken with respect to the related proposal for § 27.1587. Comments submitted for Proposal 2-100 will be considered at that time.

Proposal 2-101. No unfavorable comments were received on the proposal to amend § 27.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2-102. No unfavorable comments were received on the proposal to amend § 27.173(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-103. No unfavorable comments were received on the proposal to amend § 27.175(d)(2)(iv). Accordingly, the proposal is adopted without substantive change.

Proposal 2-104. No unfavorable comments were received on the proposal to amend § 27.321(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-105. No unfavorable comments were received on the proposal to amend § 27.339. Accordingly, the proposal is adopted without substantive change.

Proposal 2-106. Two commentators suggested that the limit pilot torque for rotorcraft twist controls in proposed §§ 27.397(b)(2) and 29.397(b)(2) should be 80 times the radius (R) in inches instead of 133 inch-pounds, as proposed. The FAA agrees that the pilot torque load requirements should be a function of the radius (R). Also the FAA does not expect the radius (R) of any twist control installed on any rotorcraft type certificated in the future to be greater than 133/80 inches. Therefore, the proposals as adopted revise the limit pilot torque load to 80R inch-pounds.

Proposal 2-107. No unfavorable comments were received on the proposal to add a new § 27.563. Accordingly, the proposal is adopted without substantive change.

Proposal 2-108. No unfavorable comments were received on the proposal to amend § 27.603. Accordingly, the proposal is adopted without substantive change.

Proposal 2-109. One commentator disagreed with proposed §§ 27.685(a) and 29.685(a) that would require the consideration of the effects of the freezing of moisture on control systems since §§ 27.685(a) and 29.685(a) currently require that control systems be designed to prevent jamming. While the explanation for this proposal indicated that the freezing of moisture was a common cause of control jamming, the proposal is also directed at preventing chafing and interference caused by the freezing of moisture. Accordingly, the proposals are adopted without substantive change.

Proposal 2-110. No unfavorable comments were received on the proposal to add a new § 27.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-111. Based on a comment received, the proposed change to § 27.787 has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2-112. No unfavorable comments were received on the proposal to add a new § 27.801. Accordingly, the proposal is adopted without substantive change.

Proposal 2-113. Several commentators stated that the ditching emergency exit standards proposed for §§ 27.807(d) and 29.807 should not be applicable to all rotorcraft. The commentators noted that the new standards would unnecessarily penalize rotorcraft that would never be involved in a ditching situation. The FAA agrees that certain rotorcraft may not operate in areas where ditching is a concern. Compliance with the ditching emergency exit standards should not be required for all rotorcraft during type certification. Therefore, the proposals as adopted have been revised to make it applicable only to rotorcraft for which ditching certification is requested. The overhead hatch requirements proposed in new §§ 27.807(d)(2) and 29.807(d)(3) are withdrawn because of the possible hazards associated with a turning main rotor. In addition, the reference in proposed § 27.807(d) to § 27.807(a) has been deleted as unnecessary, and the reference in proposed § 29.807(d) to § 29.807(c) has been deleted as inappropriate.

Proposal 2-114. For comments related to the proposed amendment of § 27.853, see Proposal 2-18.

Proposal 2-115. Upon further FAA review proposed §§ 27.865(a) and 29.865(a) concerning external load attaching means have been revised to preclude the necessity of considering the application of an external load at angles that will not be obtained in service. One commentator objected to the requirement for a manual mechanical control for the quick-release device. The commentator stated that this requirement was too restrictive due to the other standby electrical systems available. The FAA does not agree. Contrary to the commentator's contention the reliability of controls other than manual mechanical controls have not been sufficiently substantiated to permit their use in place of an manual mechanical control.

Proposal 2-116. One commentator objected to the proposals to add new standards concerning turbine engine installations to §§ 27.903 and 29.903 that would be substantively identical to proposed § 23.903(b). The commentator requested that the proposals be withdrawn since helicopter service experience does not indicate that such a standard is necessary and due consideration has not been given to the differences between helicopter and airplane engine control systems. The FAA disagrees. While there are differences between helicopter and airplane engine installations, the FAA believes that the proposals would provide general design requirements relating to engine operating limitations and engine installation requirements and that these engine installation requirements should be paralleled in Parts 23, 27, and 29. Also see Proposal 2-19.

Proposal 2-117. For comments concerning proposed § 27.917(d), see Proposal 2-163.

Proposal 2-118. The proposed change to § 27.927 concerning the torque transmission test is related to a proposed amendment to § 27.927 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866; May 19, 1975). The proposed amendment to § 27.927 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2-118 will be considered at that time.

Proposal 2-119. No unfavorable comments were received on the proposal to add a new § 27.939(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-120. No unfavorable comments were received on the proposal to amend § 27.977. Accordingly, the proposal is adopted without substantive change.

Proposal 2-121. Two commentators objected to the proposals to amend §§ 27.999(b) and 29.999(b) to require the installation of quick actuation type drain valves that are readily accessible, which can be easily opened and closed, and is either located or protected so that it will not be damaged in the event of a landing with landing gear retracted. The commentators stated that the requirement to include crash landing consideration is not considered appropriate since there are a great number of other areas which must be covered in crash landing conditions. The proposals, however, would require that the fuel system drain valves be either located or protected so that it will not be damaged in the event of a landing with landing gear retracted. There are no requirements in the proposal for consideration of crash landing conditions.

In consideration of comments discussed under Proposals 2-26, and 2-70, §§27.999-(b)(3)(ii) and 29.999(b)(3)(ii), as adopted, have been clarified to more specifically provide a design consideration.

See Proposals 2-26 and 2-70.

Proposal 2-122. No unfavorable comments were received on the proposal to amend § 27.1043(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-123. No unfavorable comments were received on the proposal to add a new § 27.1093(c). The proposal as adopted has been editorially changed to agree with the format of the current section.

Proposal 2-124. No unfavorable comments were received on the proposal to add a new § 27.1123. Accordingly, the proposal is adopted without substantive change.

Proposal 2-125. No unfavorable comments were received on the proposal to add a new § 27.1143(d), and the proposal is adopted without substantive change. However, the heading of § 27.1143 has been amended to reflect the contents of the section after the adoption of a new paragraph (d).

Proposal 2-126. No unfavorable comments were received on the proposal to amend § 27.1185. Accordingly, the proposal is adopted without substantive change.

Proposal 2-127. For comments related to proposed amendment of § 27.1322, see Proposals 2-34 and 2-82.

Proposal 2-128. The proposed change to § 27.1325 concerning the static pressure sources is related to a proposed amendment to § 27.1325 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems. Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposed amendment to § 27.1325 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-128 will be considered at that time.

Proposal 2-129. The proposal for a new § 27.1329 concerning the standards for automatic pilot systems is related to a proposed new § 27.1311 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and System Proposals (Notice 75-23; 40 FR 23048; May 27, 1975). The proposal for § 27.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking is taken with respect to the related proposal in Notice 75-23. Comments for Proposal 2-129 will be considered at that time.

Proposal 2-130. No unfavorable comments were received on the proposal to amend § 27.1351. Accordingly, the proposal is adopted without substantive change.

Proposal 2-131. Proposed § 27.1353(f) concerning nickel-cadmium batteries is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1353(f) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-131 will be considered at that time.

Proposal 2-132. For comments related to the proposal amendment of § 27.1385 and the withdrawal of the proposal, see Proposal 2-89.

Proposal 2-133. No unfavorable comments were received on the proposal to amend § 27.1411. Accordingly, the proposal is adopted without substantive change.

Proposal 2-134. No unfavorable comments were received on the proposal to amend § 27.1415(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-135. The proposed change to § 27.1545 concerning the V_{ne} requirements is related to a proposed amendment to § 27.1505 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1545 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-135 will be considered at that time.

Proposal 2-136. For comments related to the proposed amendment of § 27.1549, see Proposal 2-42.

Proposal 2-137. No unfavorable comments were received on the proposal to amend § 27.1555(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-138. No unfavorable comments were received on the proposal to amend § 27.1557(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-139. The proposed change to § 27.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-139 will be considered at that time.

Proposal 2-140. The proposed change to § 27.1587 is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-140 will be considered at that time.

Proposal 2-141. One commentator suggested that the proposed new § 29.25(c) provisions be limited to category B rotorcraft. However no reason for the suggestion was stated. The FAA knows of no reason why the proposed provisions should be limited to category B rotorcraft. One commentator questioned the applicability of proposed new § 29.25(c) and noted that a clarification of the applicable flight requirements was needed. For discussion of this and other comments related to the proposed new § 29.25(c), see Proposal 2-99.

Proposal 2-142. No unfavorable comments were received on the proposal to amend § 29.63. Accordingly, the proposal is adopted without substantive change.

Proposal 2-143. Several commentators recommended that § 29.67(a)(1) be revised by adding the term "at V_{TOSS}" following the words "feet per minute", and by deleting the phrase "without ground effect". Although paragraph (a)(1)(iv) of § 29.67 as proposed defines the speed to be used in meeting the climb requirements of § 29.67(a)(1) as the takeoff safety speed, the FAA does not believe that the term "V_{TOSS}" is appropriate. Also the FAA does not agree that the phrase "without ground effect" should be deleted from § 29.67(a)(1). The FAA requires that all climb performance be conducted outside the influence of ground effect. Accordingly, the proposal is adopted without substantive change.

Proposal 2-144. No unfavorable comments were received on the proposal to amend § 29.71. Accordingly, the proposal is adopted without substantive change.

Proposal 2-145. No unfavorable comments were received on the proposal to amend § 29.75(b)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 2-146. No unfavorable comments were received on the proposal to amend § 29.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2-147. No unfavorable comments were received on the proposal to amend § 29.173(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-148. No unfavorable comments were received on the proposal to amend § 29.175(d)(2)(iv). Accordingly, the proposal is adopted without substantive change.

Proposal 2–149. For comments related to the proposed amendment of § 29.397, see Proposal 2–106.

Proposal 2–150. No unfavorable comments were received on the proposal to add a new § 29.563. Accordingly, the proposal is adopted without substantive change.

Proposal 2–151. No unfavorable comments were received on the proposal to amend § 29.603. Accordingly, the proposal is adopted without substantive change.

Proposal 2–152. For comments related to the proposed amendment of § 29.685(a), see Proposal 2–109.

Proposal 2–153. No unfavorable comments were received on the proposal to add a new § 29.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–154. The proposed change to § 29.783 concerning the requirements applicable to "airstair doors" in transport category rotorcraft is related to proposed amendments to § 25.783 that are contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75–10; 40 FR 10802; March 7, 1975) and in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.783 contained in Notice 75–10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–31. The proposed amendment to § 29.783 contained in Notice 75–10 is therefore being deferred until final ruelmaking action is taken with respect to the related proposal for § 25.783. Comments submitted for Proposal 2–154 will be considered at that time.

Proposal 2–155. No unfavorable comments were received on the proposed new § 29.787(d). However, based on a comment received on Proposal 2–111, this proposal has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2–156. No unfavorable comments were received on the proposal to add a new § 29.801. Accordingly, the proposal is adopted without substantive change.

Proposal 2–157. For comments related to the proposed amendment § 29.807, see Proposal 2–113.

Proposal 2–158. No unfavorable comments were received on the proposal to add a new § 29.813(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–159. One commentator objected to the proposed change to § 29.815 for the same reasons as presented for the proposed change to § 25.815. The discussion of § 25.815 in Proposal 2–62 deals with this comment.

Proposal 2–160. For comments related to the proposed amendment of § 29.853, see Proposal 2–18.

Proposal 2–161. For comments related to the proposed new § 29.865, see Proposal 2–115.

Proposal 2–162. No unfavorable comments were received on the proposal to amend § 29.903(c)(1). Accordingly, the proposal is adopted without substantive change. For comments related to the proposal to add new standards concerning turbine engine installation, see Proposals 2–19 and 2–116.

Proposal 2–163. The only public comment received in response to proposed §§ 27.917(d) and 29.917(a) recommended that the present language in § 29.917(a) be used but gave no reason for the recommendation. The FAA believes that there should be a positive description of the cooling fans that must be considered as part of the rotor drive system. Accordingly, the proposals are adopted without substantive change.

Proposal 2–164. The proposed change to § 29.927 concerning the torque transmission test time is related to a proposed amendment to § 29.927 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410, July 11, 1975). The proposed amendment to § 29.927 contained in Notice No. 2 is therefore deferred until final rulemaking section is taken with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 2–164 will be considered at that time.

Proposal 2–165. No unfavorable comments were received on the proposal to amend § 29.931. Accordingly, the proposal is adopted without substantive change.

Proposal 2-166. No unfavorable comments were received on the proposal to add a new § 29.939(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-167. No unfavorable comment was received on the proposal to amend § 29.951(a). Accordingly, the proposal is adopted without substantive change. Also see proposal 2-68.

Proposal 2-168. No unfavorable comments were received on the proposal to amend § 29.997. Accordingly, the proposal is adopted without substantive change.

Proposal 2-169. Based on comments concerning proposed changes to § 25.979, proposed new paragraphs (d) and (e) of § 29.979 have also been revised. See Proposal 2-69 for a discussion of the amendment to § 25.979.

Proposal 2-170. One commentator objected to the proposal to § 29.999 on the basis that the helicopter accident records do not show "any great number due to operators not draining fuel sumps." The FAA believes that this low accident rate due to water contamination in the fuel exists because most helicopters already use quick actuation drain valves.

On commentator questioned the need for proposed § 29.999(b) noting that current § 29.971(d) appears to have the same requirement. The FAA agrees that current § 29.971(d) would be redundant for fuel tank sump drains and has therefore deleted the standards for the fuel tank slump drain in § 29.971(d).

The fuel drain standards in § 29.999(b) as proposed are applicable to each drain required by § 29.999(a) including the drains prescribed in § 29.971, but to avoid misinterpretation the section as adopted is clarified to specifically note the fuel tank sump drains prescribed in § 29.971.

Also see Proposals 2-26, 2-70, and 2-121.

Proposal 2-171. One commentator stated that proposed § 29.1041(a) should be revised to except "ground use only" auxiliary power units (APU's). The FAA disagrees. APU's that are permitted to operate only on the ground have inadvertently continued to operate in flight. Safe operation of APU's requires consideration of ground, water, and flight operating conditions. The proposal is therefore, adopted without substantive change.

Proposal 2-172. No unfavorable comments were received on the proposals to amend § 29.1043(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-173. No unfavorable comments were received on the proposal to add a new § 29.1093(c). The proposal as adopted has been editorially changed to agree with the format of the current section.

Proposal 2-174. For comments related to the proposed amendment of § 29.1125, see Proposals 2-29 and 2-75.

Proposal 2-175. No unfavorable comment was received on the proposal to amend § 29.1143 and the proposal is adopted without substantive change. However, the heading of § 29.1143 has been amended to reflect the contents of the section after the addition of a new paragraph (e).

Proposal 2-176. No unfavorable comments were received on the proposal to amend § 29.1165(f). Accordingly, the proposal is adopted without substantive change.

Proposal 2-177. Two commentators objected to the selective use of Part 33 requirements in the proposal for a new § 29.1167 that would provide substantiation requirements for accessory gearboxes that are not certificated as part of an engine. The FAA proposed to amend Part 29 like Part 25 for consistency. The FAA now believes that the proposed new § 29.1167 is inappropriate in view of the requirements to substantiate the rotor drive system including gearboxes under the rotor drive system endurance test requirements. Therefore, proposed new § 29.1167 is withdrawn.

Proposal 2-178. No unfavorable comments were received on the proposal to amend § 29.1189(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-179. No unfavorable comments were received on the proposal to amend § 29.1197(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-180. For comments related to the proposed amendment of § 29.1303(d), see Proposal 2-79.

Proposal 2-181. No unfavorable comments were received on the proposal to amend § 29.1307. Accordingly, the proposal is adopted without substantive change.

Proposal 2-182. For comments related to proposed amendment of § 29.1322, see Proposals 2-34 and 2-82.

Proposal 2-183. For comments related to the deferral of proposed § 29.1325, see Proposal 2-35.

Proposal 2-184. The proposed change to § 29.1329 concerning automatic pilot systems is related to a proposed new § 29.1311 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75-23; 40 FR 23048; May 27, 1975)). The proposal for § 29.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-23. Comments submitted for Proposal 2-184 will be considered at that time.

Proposal 2-185. The proposed change to § 29.1337 concerning the auxiliary power unit instrument lines is related to a proposed amendment to § 29.1337 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75-19; 40 FR 21866, May 19, 1975). The proposed amendments to § 29.1337 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-19. Comments submitted for Proposal 2-185 will be considered at that time.

Proposal 2-186. Proposed § 29.1353(c)(5) concerning nickel-cadium batteries is related to a proposed amendment to § 29.1585 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1353(c)(5) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-186 will be considered at that time.

Proposal 2-187. For comments related to the proposed amendment of § 29.1385 and the withdrawal of the proposal, see Proposal 2-89.

Proposal 2-188. The proposal for § 29.1545 concerning the V_{ne} requirements is related to a proposed amendment to § 29.1505 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1545 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-188 will be considered at that time.

Proposal 2-189. For comments related to the proposed amendment of § 29.1549, see Proposal 2-42.

Proposal 2-190. No unfavorable comments were received on the proposal to amend § 29.1555(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-191. No unfavorable comments were received on the proposal to amend § 29.1557(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-192. The proposed change to § 29.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 29.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75-25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75-25. Comments submitted for Proposal 2-192 will be considered at that time.

Proposal 2-193. No unfavorable comments were received on the proposal to amend § 31.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2-194. No unfavorable comments were received on the proposal to amend §§ 31.11 and 31.20. Accordingly, the proposal is adopted without substantive change.

Proposal 2-195. No unfavorable comment was received on the proposal to add a new § 31.14 concerning weight limits of manned free balloons. Therefore, the section is adopted without substantive change.

Proposal 2-196. No unfavorable comments were received on the proposal to amend § 31.45. Accordingly, the proposal is adopted without substantive change.

Proposal 2-197. No unfavorable comments were received on the proposal to add a new § 31.46. Accordingly, the proposal is adopted without substantive change.

Proposal 2-198. No unfavorable comments were received on the proposal to amend § 31.63. Accordingly, the proposal is adopted without substantive change.

Proposal 2-199. No unfavorable comments were received on the proposal to amend § 31.85. Accordingly, the proposal is adopted without substantive change.

Proposal 2-200. No unfavorable comments were received on the proposal to amend § 33.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2-201. No unfavorable comments were received on the proposal to amend § 35.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2-202. No unfavorable comments were received on the proposal to amend § 35.39. Accordingly, the proposal is adopted without substantive change.

Proposal 2-203. No unfavorable comments were received on the proposal to amend § 35.41(e). Accordingly, the proposal is adopted without substantive change.

Proposal 2-204. No unfavorable comments were received on the proposal to amend § 35.45(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-205. No unfavorable comments were received on the proposal to amend § 91.14 Accordingly, the proposal is adopted without substantive change.

Proposal 2-206. No unfavorable comments were received on the proposal to amend § 91.21(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-207. One commentator suggested that the proposed change to § 91.33(d) (6) concerning clock requirements should use the language of § 121.305. The FAA believes that a standard should be specified in § 91.33(d)(6) for digital clocks and the proposal as adopted provides a specific standard. See Proposal 2-79.

Proposal 2-208. The intent of the proposed new § 91.193(g) is to require protective breathing equipment that would meet the standards proposed for § 25.1439(b) on certain airplanes operated under Part 91 Subpart D. Based on the current testing being conducted on this type of equipment, the FAA is developing new standards for a later rulemaking action. The proposal for § 25.1439(b)(2)(ii) is being withdrawn (See Proposal 2-91). Therefore, the FAA believes that the proposal for § 91.193 is premature, and the proposal is withdrawn.

Proposal 2-209. Although no unfavorable comment was received on the proposed revision of § 91.209, the FAA believes that revision of similar ice protection provision in § 135.85 may be necessary. Amendments to §§ 91.209 and 135.85 should be considered together. Therefore, the proposed change to § 91.209 is withdrawn.

Proposal 2-210. No unfavorable comments were received on the proposal to amend § 121.171(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-211. No unfavorable comments were received on the proposal to amend § 121.199. Accordingly, the proposal is adopted without substantive change.

Proposal 2-212. No unfavorable comments were received on the proposal to amend §§ 121.331(b) and 121.333(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-213. The intent of proposed § 121.337(d) is to require protective breathing equipment that would meet the proposed requirements of § 25.1439(b) installed in certain airplanes operated under Part 121. However, proposed § 25.1439(b)(2)(ii) is withdrawn in this notice. Based on the current testing being conducted on this type of equipment, the FAA is developing new standards for a later rulemaking action. The FAA therefore believes that the proposed change to § 121.337 is premature and the proposal is withdrawn. Also see Proposal 2-91.

Proposal 2-214. No unfavorable comments were received on the proposal to amend § 127.105. Accordingly, the proposal is adopted without substantive change.

Proposal 2-215. No unfavorable comments were received on the proposal to add a new § 127.106. Accordingly, the proposal is adopted without substantive change.

Proposal 2-216. One commentator objected to the proposed amendment to § 133.1. The commentator stated that the proposal specifically eliminates the reference to airworthiness certification rules when, in fact, Subpart D is retained intact except for the standards for external-load attaching means and quick-release devices. The FAA agrees that reference to airworthiness requirements should not be deleted without other changes to Part 133, and the proposal is withdrawn.

Proposal 2-217. One commentator objected to the proposed amendment to § 133.41 (c)(6). However no reason for the objection was stated. The proposal is therefore adopted herein without substantive change.

Proposal 2-218. One commentator requested that proposed § 133.43(a) be revised to provide for the use of external-load attaching means previously approved under Part 133. The FAA agrees and proposed § 133.43 is revised accordingly.

Proposal 2-219. No unfavorable comments were received on the proposal to amend § 133.45(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2-220. No unfavorable comments were received on the proposal to amend § 135.71(a)(5). Accordingly, the proposal is adopted without substantive change.

Proposal 2-221. Based upon further review by the FAA proposed § 135.165(b)(2) is being withdrawn because contrary to the explanation for the proposal in Notice 75-10, the proposal would result in unjustifiably different standards for transport category airplanes operated under Part 135 and those operated under Part 121.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); sec. 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, and for the reasons stated in Notice 75-10, Parts 21, 23, 25, 27, 29, 31, 33, 35, 91, 121, 127, 133, and 135 of the Federal Aviation Regulations are amended as follows, effective February 1, 1977.

The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A-107.

Amendment 25–39

Type A Passenger Emergency Exit Capacity

Adopted: December 29, 1976 **Effective: February 10, 1977**

(Published in 42 FR 2052, January 10, 1977)

The purpose of this amendment to §§ 25.807(c)(2) and (c)(3) of Part 25 of the Federal Aviation Regulations (FAR) is to revise the maximum passenger seating configuration allowed for each pair of Type A exits from 100 to 110 for the type certification of transport category airplanes.

This amendment is based upon a proposal contained in a Notice of Proposed Rule Making (Notice 75–40 published in the Federal Register on December 23, 1975 (40 FR 59354). Notice 75–40 was based, in part, upon comments received in response to an Advance Notice of Proposed Rule Making published on May 10, 1974 (Notice 74–19, 39 FR 16900). Except as discussed herein, the reasons for this amendment are the same as those contained in Notice 75–40. The relevant comments are discussed below. Interested persons have been afforded an opportunity to participate in the making of this amendment and due consideration has been given to all matter presented.

In general, the comments received in response to Notice 75–40 repeated issues that were raised in comments to Notice 74–19 and subsequently discussed in the preamble of Notice 75–40. Only the more significant of these repetitive comments are discussed herein.

Several commentators who favored an increase in the passenger seating limit for Type A exits contended that the limit could be safely increased to 117 or more. One of these commentators stated that the 117 value is approximately 85 percent of the demonstrated exit capacity as obtained from emergency evacuation tests. The commentator also stated that computer simulated emergency evacuation exercises indicated that 117 passengers could be successfully evacuated through a Type A exit to the ground within 90 seconds. Based on this, the commentator asserted that a passenger seating limit of 117 for each pair of Type A exits would be very conservative and would assure adequate passenger safety levels considering the possible existence of unknown factors which could affect in-service evacuations.

To the contrary, the commentators opposed to the proposed amendment asserted that the amendment would result in a reduction in the safety provided airplane occupants because of a lack of in-service Type A exit system reliability. In this connection, one commentator stated that during a recent year and one-half period at least seven accidents and incidents have occurred, with aircraft having Type A exits, that involved emergency evacuations and that 16 of the 37 Type A exits installed on the aircraft involved were unusable because of exit failures. Several commentators referenced a National Transportation Safety Board Special Study to indicate the problems associated wth the maintenance, installation, and design, of current Type A exit systems and crew training related to exit use. The NTSB Special Study as well as several proposals made to the First Biennial Operations Review Program, relating to the reporting of in-service exit system problems, were referenced by commentators to indicate that Type A exit reliability cannot be accurately determined. With respect to basing a rule change on emergency evacuation test data, an FAA study was referenced to indicate the lack of realism in emergency evacuation tests.

As discussed in Notice 75–40, the regulatory provisions relating to Type A exits in FAR § 25.807 were adopted by Amendment 25–15, effective October 24, 1967. That amendment also established the provision in § 25.803(c) that manufacturers show by demonstration that the maximum seating capacity of an airplane having a capacity of more than 44 passengers can be evacuated to the ground within 90 seconds, under conditions prescribed in the regulation. The preamble of Amendment 25–15 indicated that the allowable passenger seating limit of 100 that was established for each pair of Type A exits was less than the evacuation capacity that had been demonstrated by test.

With respect to the comments received that advocated a passenger seating limit in excess of 110, the data presented as justification was based on insufficiently conservative maximum evacuation times and minimum passenger flow rates. The suggested passenger seating limit based on that data is, therefore, also insufficiently conservative.

In regard to the issues raised by the commentators objecting to any increase in the passenger seating limit for Type A exits, the FAA has found no compelling justification for not adopting the proposed amendment. Since the adoption of Amendment 25–15 there have been a number of improvements in the design and maintenance of Type A exit systems. In tests, these systems have functioned in a reliable manner. The FAA believes that in-service reliability of Type A exit systems now warrants an increase in the passenger seating limit. In this connection, the FAA is unaware of any situation in which a passenger has been prevented from evacuating an airplane because of a Type A exit system failure in an accident referenced by the commentators. Furthermore, the FAA expects Type A exit system performance to improve in the future. The proposals referenced by the commentators that were submitted to the Biennial Operations Review Program (Notice 75–9, 40 FR 8685) are related to achieving such a result. Regarding emergency evacuation demonstration realism, those demonstrations are made as realistic as possible and are more demanding than numerous actual emergency evacuations. Moreover, it should be noted that passenger seating limits are not entirely based on data obtained from emergency evacuation demonstrations and that those demonstrations are conducted with one-half of the airplane's exits not being used. Based on the comments and the data available, the increase in the type certification passenger seating limit for Type A exits from 100 to 110, being adopted herein, is justified and will provide for more economic airplane utilization with no adverse effect on safety.

One commentator presumed that the new passenger seating limit for Type A exits could be applied to existing aircraft. That presumption is correct. Under the provisions of Subparts D and E of FAR Part 21, relating to type certificate changes, application could be made for approval of an increased passenger seating capacity for existing aircraft types. The FAA does not agree with the same commentator's contention that additional emergency evacuation demonstrations would never be necessary after such an increase. The evacuation demonstration requirements of FAR §§ 25.803 and 121.291 are necessary to properly evaluate an entire emergency evacuation system. It should be noted, however, that §§ 25.803 and 121.291, by their own terms, might not require new evacuation demonstrations, depending on the extent of the increase in passenger seating capacity and the extent of cabin configuration change.

This amendment is made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423) and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, Part 25 of the Federal Aviation Regulations is amended effective February 10, 1977.

The FAA has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A–107.

Amendment 25-40

Airworthiness Review Program—Amendment No. 4: Powerplant Amendments

Adopted: March 10, 1977 **Effective: May 2, 1977**

(Published in 42 FR 15034, March 17, 1977)

The purpose of these amendments is to update and improve the airworthiness standards applicable to the type certification of aircraft engines and propellers and of aircraft with respect to the provisions relating to powerplant installations.

These amendments are the fourth in a series of amendments to be issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR Citation*
Form number and clarifying revisions.	40 FR 2576; Jan. 14, 1975.
Rotorcraft anticollision lights standards.	41 FR 5290; Feb. 5, 1976.
Miscellaneous amendments.	41 FR 55454; Dec. 20, 1976.

These amendments are based on two Notices of Proposed Rule Making—Notice 75-10 published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802); and Notice 75-19 published in the FEDERAL REGISTER on May 19, 1975 (40 FR 21866). The amendments based on Notice 75-10 were deferred in the series of amendments titled "Miscellaneous Amendments" (41 FR 55454; Dec. 20, 1976) so that they could be considered in conjunction with the final disposition of certain proposals in Notice 75-19. The discussions of the comments received for the deferred proposals are included under the heading of the related Notice 75-19 proposals.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for the minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notices 75-10 and 75-19.

The following discussion is keyed to the like-numbered proposals contained in Notice 75-19:

Proposal 3-1. In commenting on proposed § 1.1, which would add definitions for "Altitude engine" and "Sea level engine," one commentator suggested that current § 91.33(b)(8) should be revised to require a manifold pressure gauge for each sea level engine equipped with a constant speed propeller, as well as for each altitude engine. The commentator stated that such a sea level engine is capable of being overboosted, if operated with the propeller adjusted for operations at high beta angles and the throttle adjusted for high power. The FAA does not agree since a "Sea level engine" as defined would be capable of producing rated takeoff power only at sea level. Therefore, the definitions of "Altitude engine" and "Sea level engine" are adopted as proposed.

Proposal 3-2. Based upon a further review, proposed new § 23.739 concerning a requirement for landing gear electrical ground connections is withdrawn.

Proposal 3-3. One commentator questioned the proposed amendment of § 23.901(b)(2) concerning easily removable engine cowls and nacelles to facilitate preflight checks. The commentator was of the opinion that the preflight check made by the pilot should be limited to oil level inspection and suggested that the proposal be revised to only require provisions so that the pilot can easily check the level of lubrication oil. The FAA does not agree with the commentator. Items other than the oil level need to be checked in the engine compartment during a preflight check and therefore the engine cowls and nacelles must be easily removable or openable by the pilot to facilitate these checks.

Another commentator objected to the phrase "sustained loss of power" in proposed § 23.901(b)(3), as being insufficiently definitive by prescribing a limit on the duration of power loss rather than the degree of power loss. The commentator suggested the use of the phrase "serious loss of power." The FAA does not agree. The phrase "sustained loss of power is consistent with present § 33.77(c), and was selected since the ingestion of rain can cause a power loss that is acceptable if it is not sustained. The commentator also objected to the prescribed rate of rain ingestion as being more severe than is presently prescribed or proposed for turbine engines in Part 25. The rain ingestion rate of 4 percent of engine airflow by weight is presently prescribed for all turbine engines of new design in § 33.77(f). Contrary to the commentator's contention, proposed § 25.1091(e) would apply the same rate in Part 25 to turbine engine installations using engines type certificated under regulations that did not include the current Part 33 requirement. The FAA believes that the rain ingestion rate is a reasonable certification requirement and is consistent with current § 33.77(f).

The commentator stated further that the moisture content should be that specified in Part 25, Appendix C, or two percent water content by weight. However, Appendix C defines an icing cloud and not a rain condition.

The commentator also stated that sufficient information regarding the collection and recording of the test data has not been provided and would be necessary to meet the requirements. The FAA did not intend to include administrative or type certification procedures in the proposal. No difficulty has been experienced in this regard during the type certification testing of turbine engines and no difficulty is foreseen in applying the proposed requirement.

The proposal is revised editorially for clarity.

Proposal 3-4. No adverse comments were received with respect to proposed deletion of § 23.939(b). The proposal, therefore, is adopted.

Proposal 3-5. No unfavorable comment was received for proposed new § 23.943, and the proposal is adopted without substantive change. See Proposal 3-26 for a discussion of related comments.

Proposal 3-6. No unfavorable comments were received on the proposal to amend § 23.959. Accordingly, the proposal is adopted without substantive change.

Proposal 3-7. In commenting on proposed § 23.967(a)(5) one commentator stated that problems of fatigue of tanks should be examined where a negative pressure could exist in the tank. The proposal covers only bladder cells and the FAA does not regard fatigue considerations to be pertinent to bladder cells. The proposal is editorially revised to ensure that the exception for zero or negative pressure is clear.

Proposal 3-8. For a discussion of comments related to proposed new § 23.973(d), see Proposal 3-31.

Proposal 3-9. Two commentators questioned proposed new § 23.975(a)(7). The commentators stated that the proposal to prevent fuel loss when the airplane is parked in any direction on a ramp having a one-degree slope did not adequately consider the problems of fuel discharged because of thermal expansion. The FAA agrees that the intent of the proposal was to consider normal parking situations but not thermal expansion. The proposal is revised to make that exception.

A commentator stated that proposed § 23.975(a)(8) could be interpreted as meaning that if at least two separate and independent vents are provided, neither has to meet the proposed requirements. The FAA believes the proposal is not clear and may cause a misinterpretation of current § 23.975(a). The proposal is therefore withdrawn.

Several commentators suggested revisions of § 23.975(a)(8). In light of the withdrawal of proposed paragraph (a)(8), these comments are not discussed.

Proposal 3-10. No unfavorable comments were received on the proposal to amend § 23.995. The proposal is revised editorially for clarity. Also see Proposal 3-13.

Proposal 3-11. For a discussion of comments related to proposed § 23.1093(b), see Proposal 3-34.

Proposal 3-12. A commentator objected to proposed § 23.1121(b) concerning the location and shielding of exhaust system parts because of a lack of specificity on how to determine whether the location of a system carrying flammable fluid is acceptable.

The FAA did not intend to state how an acceptable location would be determined since a number of acceptable methods might exist. The commentator also pointed out the possibility that a shield located close to a hot component might become hot enough to ignite flammable fluid. The FAA agrees and proposed §§ 23.1121(b), 25.1121(d), 27.1121 (d), and 29.1121(b) have been revised to make it clear that shields used for shielding exhaust system parts are also parts of the exhaust system. The commentator also questioned whether the flammable fluid leak sources to be considered are those around fittings or include those caused by rupture of a fluid carrying line. Proposed § 23.1121(b) covers any leakage from a flammable fluid system, including fluid-carrying lines and fittings, as well as the joints between them. Finally, the commentators stated that consideration should be given to fire detection and extinguishing equipment in showing compliance with proposed § 23.1121(b). The FAA does not agree since it is necessary to take steps to both prevent and control fires.

A commentator stated that proposed § 23.1121(b) would make an adequate design difficult to achieve and contended that the resultant design would be complex with an inherent lower reliability than a simple system. The FAA does not agree. The proposal specifically allows the use of exhaust system shielding as a method of avoiding impingement of flammable fluids. Therefore, the FAA believes the proposal would reduce design difficulties. The commentator also stated that it would be virtually impossible to prove whether the objective of the proposal had been met. The FAA does not foresee any difficulty in administering the requirement.

No unfavorable comments were received on the proposed new § 23.1121(h). Accordingly, the proposal is adopted without substantive change.

Proposal 3-13. A commentator noted that proposed § 23.1141(g)(1) would prohibit the use of a rotary type switch for selecting fuel supply from more than one tank, and suggested that the proposal be revised to read: "For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position." The FAA agrees and proposed §§ 23.1141(g)(1), 25.1141(f)(1), 27.1141(c)(1), and 29.1141 (f)(1) are revised accordingly.

Several commentators concurred with proposed §§ 23.1141(g)(2) and 25.1141(f)(2) but believed that the pilot might not have a clear picture of the effect of valve position and recommended that the proposal be revised to require means to indicate proper valve operation to the flight crew. Another commentator stated that it is unnecessary to require indication of actual valve position with power-assisted valves and that it would be sufficient to indicate open and closed positions. Proposed §§ 23.1141(g)(2) and 25.1141(f)(2) were not intended to require an indication of the proper functioning of a power-assisted valve or to require an indication of each of the numerous possible valve positions. In addition, the proposal, as stated in the explanation, would recognize the acceptability of intransit light indicators. Therefore, proposed §§ 23.1141(g)(2), 25.1141 (f)(2), 27.1141(c)(2), and 29.1141(f)(2) have been revised accordingly.

Proposal 3-14. No unfavorable comment was received on the proposal to amend § 23.1145(c). However, see the discussion of Proposal 3-40 for a revision of proposed § 23.1145(c).

Proposal 3-15. One commentator suggested that proposed § 23.1193(f) be revised to require a "fireproof" standard and to combine it with the fireproof standard for cowlings in current § 23.1193(e). The FAA does not agree since adopting the suggestion would result in an unduly severe provision. The proposal offers the design alternatives for multiengine airplanes with supercharged engines of fireproof nacelle skin or fireproof cowling skin. Furthermore, the proposal is consistent with a similar provision in Part 25.

A second commentator believed that there should be a tradeoff between fire detection and extinguishment requirements. The FAA believes that both this proposal relating to fire containment and Proposal 3-16 relating to fire detection are necessary in light of service experience. The commentator also felt that the proposal should refer only to engines with mechanically driven superchargers and not to all supercharged engines. The FAA disagrees since there have been fires on supercharged engine installations other than those with mechanically driven superchargers and the proposal is applicable to all supercharged multiengine powered airplanes.

Another commentator questioned whether the reference in the proposal to supercharged engines was intended to include engines with turbo-superchargers. The term "supercharged" covers both mechanical and turbo-supercharged engines.

Proposal 3–16. One commentator requested that proposed new § 23.1203 concerning fire detector systems be revised to exclude turbocharged multiengine powered airplanes because these airplanes are not any more susceptible to fire than airplanes with sea level engines. The FAA disagrees. Service experience indicates that multiengine powered airplanes incorporating turbo-superchargers are more susceptible to fires than those that do not incorporate turbo-superchargers.

Another commentator opposed the proposal on the grounds that fire detection systems have not been shown to be necessary for general aviation aircraft and that the emphasis should be placed on fire prevention. The commentator also stated that there has been a history of false fire detection signals that have resulted in unscheduled landings and needless engine shut-downs. The FAA agrees that fire prevention is important and proposals have been made in the Airworthiness Review Program to enhance aircraft fire prevention capabilities. However, there is a need to require fire detection provisions so that early action can be taken if a fire occurs. Also, false fire warnings, associated with early detection systems on transport category airplanes, do not occur to an unacceptable degree in present detector systems which have the benefit of many years of service experience and technical improvements. The proposal is adopted with only minor editorial changes.

Proposal 3–17. For a discussion of the withdrawal of proposed § 23.1305(h), see Proposal 3–59.

For a discussion of comments on proposed § 23.1305(w) concerning fire warning indicators for those airplanes required to comply with § 23.1203, see Proposal 3–16.

Proposal 3–18. One commentator agreed with the intent of the proposal for § 23.1337 (a) concerning powerplant instruments and instrument lines that utilize flammable fluids, but suggested a number of changes to make the provision more specific. The FAA does not agree. Flexibility in the requirement is necessary to avoid creating unnecessary design restrictions. The commentator suggested that a fire extinguisher be specified for compliance with the proposed rule. The FAA does not agree. The intent of the proposal is to prevent the occurrence of a fire hazard.

Another commentator did not concur with the proposal on the grounds that §§ 23.853 (d) and 23.993 adequately cover its intent and it would result in undue crowding in the cockpit area. The FAA disagrees. The proposal contains necessary provisions not covered by § 23.993 and deals with locations not covered by § 23.853(d). In addition, the FAA has no data to indicate that crowding in the cockpit area would result from the proposal.

Proposals 3–19 and 2–44. Proposed § 23.1557(e) was intended to implement the requirement in Proposal 3–2 and is withdrawn because of the withdrawal of that proposal.

Disposition of Proposal 2–44 to amend § 23.1557 (Notice 75–10) was deferred so that it could be considered in connection with Proposal 3–19. No unfavorable comment was received on Proposal 2–44. Accordingly, the proposal is adopted without substantive change.

Proposal 3–20. Based upon a further review, proposed new § 25.739 concerning a requirement for landing gear electrical ground connections is withdrawn.

Proposal 3–21. One commentator suggested that the installation instructions of proposed § 25.901(b)(1)(i) should be limited to those installation design parameters pertinent to the engine type certificate. The installation instructions provided under § 33.5 include only those parameters referred to by the commentator, and the FAA believes that a revision of the proposal is not needed. Also see Proposal 3–51.

Two commentators objected to the use of the term "extremely remote" in proposed § 25.901(c) as not being clearly understood. The FAA believes the term is appropriate since it has been used in other sections of the regulations, without administrative difficulty, to establish the consideration that must be given to the failure of structural components during the evaluation of the type design.

One commentator believes that the proposal would make § 25.1309 inapplicable to powerplant or APU installations. The FAA disagrees; § 25.1309 would continue to apply to powerplant and APU installations.

Another commentator concurred with the proposal if, with respect to APUs, it is limited to those approved for use in flight. The FAA does not believe the proposal should be so limited since the failure or malfunction of an APU approved for use only on the ground could jeopardize safe operation on the ground and in flight. The proposal is adopted without substantive change.

Proposal 3-22. One commentator recommended revising proposed § 25.903(e)(2) to require only the establishment of an envelope that defines the inflight restart capability. The FAA disagrees since this recommendation would not explicitly require restart capability, which was the intent of the proposal and which the FAA believes is essential for safe operation.

Another commentator questioned the deletion of the fire resistant requirement for engine restarting from current § 25.903(c). The FAA believes, due to the very limited use of an engine after a fire in the engine, that the benefit of requiring the components of the restarting system to be fire resistant are slight. The FAA thus can no longer justify this requirement.

A commentator did not concur with proposed § 25.903(e)(3) because it provides for ignition but not for rotational capability sufficient for an engine start. The proposal however was not intended to require a power source for rotation where windmilling speeds are too low for restarting. The proposal would provide the necessary electrical power for engine ignition whether or not the windmilling speed was adequate for an engine start. The proposal is adopted without substantive change.

Proposal 3-23. Several commentators believed the reference in proposed § 25.933(a) to engine idle forward thrust was misleading and that the word "forward" should be deleted. One commentator suggested the word "reverse" be used instead of "forward". However, the direction of the thrust produced by the engine is not pertinent to the proposal. The resultant thrust is controlled by the reverser position. Therefore, the word "forward" is deleted.

One of the commentators believed that the allowable engine thrust setting should be stated as a percent of maximum or in terms of aircraft performance. The commentator suggested "flight idle" be used in place of "idle". The proposal was intended to require the engine thrust to be reduced to the thrust produced at idle in flight and the proposal has been revised to specify flight idle. The same commentator believed the proposal could be interpreted to include the malfunction of all reversers and an unlimited combination of failure modes. The proposed lead-in paragraph (a) is revised to make it clear that consideration must be given to each reverser but only one reversal at a time.

Another commentator recommended that the proposal be revised to require the prevention of inadvertent thrust reversal in flight. The FAA disagrees. Section 25.1155 currently requires consideration of inadvertent operation for each reverse thrust control.

A commentator stated that present § 25.933(d) covers the proposal. The FAA does not agree. Proposed § 25.933(a) would apply to all cases of in-flight thrust reversal of a reverser intended for ground operation only. Section 25.933(d) on the other hand applies only to malfunctions of the thrust reverser system that affect directional control.

Another commentator suggested that the word "condition" at the end of the proposed paragraph (a)(2) should be changed to "position". The FAA agrees that the significant status of the reverser is its position and the proposal is revised accordingly.

Finally, a commentator stated in view of the requirements in § 25.1155, proposed § 25.933(a) should be limited to systems failures. The FAA disagrees. The consequence of an in-flight thrust reversal is the same whether the reversal results from malfunction or the control is moved to the reverse position. Both situations have occurred in service and need consideration. The commentator also suggested replacing "possible" by "probable" in proposed § 25.933(a)(2) because "possible" does not define the limit of failure analysis or test configuration that has to be considered. However, the FAA believes that any degree of deployment of the reverser should be considered.

Proposal 3-24. No unfavorable comment was received on the proposal to delete § 25.939(b) and the proposal is adopted.

Proposal 3-25. One commentator suggested that the heading of proposed new § 25.941 be revised to read "Thrust or power augmentation system" for clarification. The FAA agrees and the heading is revised as suggested. The same commentator also pointed out that the section designation § 25.941 had been used in connection with another proposal in Notice 75-10. The FAA agrees and the section as adopted is designated as § 25.945.

A commentator suggested that proposed § 25.941(b)(2) should be clarified by adding the word "maximum" before the language "operating pressure". The FAA agrees, and the proposal as adopted has been so clarified.

A commentator referring to proposed § 25.941(b)(3), stated that it is not necessary to specify how the venting should be done and suggested that the proposal be revised to require that the venting arrangements for each tank must perform their intended functions under any foreseeable conditions. While the FAA does not agree with the revision suggested by the commentator, the FAA does agree that the vent need not be from the "top" of the expansion space. If the venting is effective under "any normal flight condition" the vent could be located in other places in the expansion space. Proposed § 25.941(b)(3) is revised accordingly to allow the applicant any needed flexibility.

Another commentator on proposed paragraph (b)(3) stated that the proposal would preclude pressurization as a means of pumping. The FAA agrees. The proposal was not intended to preclude pressurization and is revised to apply only to vented tanks.

A commentator suggested a revision of proposed § 25.941(b)(4) that would require marking each tank filler cap to specify "usable tank capacity" rather than tank capacity. However, after further review the FAA does not believe a requirement for marking the cap with "tank capacity" or "usable tank capacity" is necessary and the requirement is deleted from the proposal.

Another commentator thought that placards should be treated separately from system design and that the proposal should be deleted because similar requirements for fuel and oil systems are being considered for deletion. The FAA believes that marking the tank fluid opening to identify the fluid to be used may avoid the inadvertent use of incorrect fluids.

One commentator stated that it is highly probable that the filler cap will not be large enough to indicate the required markings and that markings adjacent to the fluid filler cap should be allowed as is the case for § 25.1557(b). The FAA agrees and paragraph (b)(4) is revised to require marking at or near the filler cover.

On the basis of comments received and upon further review, the FAA believes that adoption of proposed § 25.941(b)(5) is not appropriate at this time and the proposal is withdrawn.

Another commentator believed that the proposal should be combined with § 25.963(e) to cover all fluid tanks. The FAA agrees that current § 25.963(e) should be combined with other augmentation system requirements but does not believe that augmentation system requirements and fuel tank requirements should be combined. Proposed § 25.941 and current § 25.963(e) are combined in a new § 25.945.

Finally, a commentator on the fuel-injection exclusion in proposed paragraph (d) questioned whether water-methanol as used on the Rolls-Royce Model 542 (Dart) would be regarded as a fuel. In the Dart application, the water-methanol system is not regarded as a fuel injection system. Therefore, the water-methanol system used on the Dart engine would not be excluded from the augmentation system requirements of § 25.945.

Proposal 3-26. Several commentators objected to proposed new § 25.943 concerning the effect of negative accelerations on engine and APU operation. One commentator recommended that the word "sustained" be used in place of the word "hazardous" in relation to which malfunctions need be considered under the proposed rules. The FAA disagrees since the significance of a malfunction is whether it is hazardous, irrespective of its duration.

A commentator did not concur with the proposal, stating that a differentiation is necessary between ground-use APUs and other APUs. The commentator apparently misinterpreted the proposal since the proposal explicitly applies to an APU only if it is approved for use in flight.

Two commentators indicated that the proposal should be limited to APUs that are essential to the safety of flight. The FAA does not agree since the malfunction of a nonessential APU approved for use in flight might be hazardous. All flight-use APUs should therefore be evaluated under the proposal.

A commentator stated that since negative acceleration could affect all engines simultaneously, the requirement should refer to "engines". The proposal applies to any engine at any point during the negative acceleration and would necessarily include a determination of the effect of negative acceleration on each engine during the entire acceleration.

One commentator requested information on the duration of acceleration to be considered. The duration of acceleration to be considered under the provision is that expected in service and depends on the maneuver-time history of the particular aircraft type being evaluated within its flight envelope. The proposal is adopted without substantive change.

Proposal 3-27. A commentator objected to the list of factors in proposed § 25.952(a) concerning characteristics that a test article must have that is used to reproduce the general fuel system. The commentator stated that in many cases the list is not complete and therefore may be misleading. Upon further review the FAA agrees that the specific list of characteristics may not be appropriate in all cases. The FAA believes that revision of the proposal to require that the test article must reproduce the operating characteristics of the portion of the fuel system to be tested will allow appropriate flexibility in determining the tests that are necessary and will eliminate the need for the list of factors which are already included within the term "operating characteristics".

Several commentators believed that the proposed § 25.952(b) was too restrictive. One commentator suggested that paragraph (b) be revised to read "The likely failure of any heat exchanger using fuel as one of its fluids may not result in a hazardous condition". The FAA agrees that contamination of either fluid does not always result in a hazardous condition and the requirement need not be as restrictive as proposed. Proposed § 25.952(b) is revised accordingly.

One commentator also commented that proposed paragraph (b) should apply only to heat exchangers that are part of the airplane fuel system and that engine heat exchangers should be controlled by a similar requirement in Part 33. The FAA disagrees. The evaluation whether contamination or other likely failure could cause a hazardous condition can only be determined in a particular airplane installation. Therefore, the proposal is applicable to airplane-furnished and engine-furnished heat exchangers.

Proposal 3-28. One commentator questioned the proposed clarification of § 25.959. While the commentator agreed that unusable fuel supply should be determined under § 25.959 without considering fuel system component failures, the commentator believed that if a failure of a fuel system component would produce a greater amount of unusable fuel that fact must be determined in certification and made known to the operator. Fuel system component failures are not a required consideration under § 25.959. However, if the FAA determines that additional information is necessary for safe operation, this information must be furnished to the operator under the requirements of subpart G of Part 25. Accordingly, the proposal is adopted without substantive change.

Proposal 3-29. One commentator stated that proposed § 25.963(f) did not contain a provision to ensure fuel flow if the regulator failed and that there should be a manual back up for the crew in the event of a system failure. The proposal was not intended to ensure continued fuel flow after a regulator failure. The required fail-safe features are only intended to ensure the prevention of over-pressurization. The FAA, furthermore, does not believe that an additional requirement for a specific manual system has been justified. The proposal is revised to ensure this intent.

Two other commentators believed that an automatic regulating means or a mechanical pressure regulating device need not be required if there are fail-safe features to prevent excessive pressure buildup. The FAA agrees and the proposal is revised to require a means with fail-safe features to prevent the buildup of excessive pressure differential between the inside and outside of the tank.

Proposed § 25.1305(a)(9) concerning powerplant instruments would have required a means to check the operation of the automatic regulating means in proposed § 25.963(f). Since paragraph (f) as revised would not require a means to regulate fuel tank pressure, an instrument to check this operation should not be required. Therefore, proposed § 25.1305(a)(9) is withdrawn.

See Proposal 3-25 for discussion of the transfer of current § 25.963(e), concerning augmentation liquid tank capacity, to § 25.945(e).

Proposal 3-30. One commentator interpreted § 25.965(d) to mean that only a pressure test is required for non-metallic fuel tanks. The commentator recommended that slosh testing be added to proposed new § 25.965(d) as a requirement for non-metallic tanks in transport category airplanes. The FAA does not agree with the recommendation since § 25.965(c) already requires slosh testing of all non-metallic tanks except where satisfactory experience with a similar tank in a similar installation can be shown.

Two commentators concurred with the proposal but believed the words "analysis or" should be inserted in conjunction with the word "tests" because analysis may be adequate in showing compliance, either alone or when combined with a limited test program. Furthermore, when the tank is an integral tank the structural loading, including aerodynamic loads, is not always amenable to test. The FAA agrees, and the proposal is revised by inserting the words "analysis or" before the word "tests".

Proposal 3-31. Sections 23.973(d) and 25.973(d), as proposed, are identical and concern the electrical bonding of the airplane and fueling equipment.

The FAA agrees with two commentators who stated that where a metal-to-metal bond is made between the airplane and the fueling equipment no need exists for separate electrical bonding of the fuel nozzle to the airplane fueling connection. The FAA believes that considering airplane and ground fueling systems being used today metal-to-metal contact will exist during pressure refueling. Therefore, the proposals are revised to except pressure fueling connection points from the fuel system electrical bonding provision.

Another commentator opposed the proposal on the grounds that there are no statistics to show that the present procedure is unsafe and that requiring special ground connections would increase cost and impose an unnecessary economic burden. The FAA does not concur because the flow rates associated with fueling without proper bonding can induce an electrostatic discharge sufficient to ignite fuel vapor.

A third commentator believed that a review of all fueling procedures should be conducted, in which the subject of grounding points would be one of several subjects to be considered, and that the review should be undertaken before any new rule affecting those procedures is adopted. The FAA agrees that an overall review of fueling procedure and equipment might be desirable; however, the FAA is not aware of any substantive reason to delay the adoption of the proposal with the change discussed above.

Proposal 3-32. No unfavorable comments were received on the proposal to amend § 25.995. Accordingly, the proposal is adopted without substantive change. Also see Proposal 3-39.

Proposal 3-33. One commentator questioned the proposed amendment to § 25.1091. The commentator stated that incorporating APU requirements into the propulsion engine requirements is confusing and unnecessary and that each APU would have to meet the propulsion engine foreign object ingestion test requirements for takeoff, flight idle, and cruise conditions although APUs do not undergo these conditions. The FAA agrees that paragraph (e) should not apply to APUs since foreign object ingestion by APUs is not considered to be a significant problem. However, the FAA believes that applicability of the other requirements to APUs is necessary for the reasons stated in the explanation for the proposal. The commentator also believed that to comply with proposed paragraph (e), the installed engine must repeat the ingestion test requirements of § 33.77. The FAA did not intend to require that the ingestion test requirements be repeated on engines that had already shown compliance with § 33.77. The FAA believes that the test required by § 33.77 during engine type certification adequately accounts for the effects of inlet ingestion on the powerplant installation. Proposed § 25.1091(e) is revised accordingly to apply only to turbine engines and to include only those engines that had not been shown during engine type certification to comply with § 33.77.

Another commentator recommended that proposed paragraph (e) be revised to require each turbine powerplant installation to "be consistent with the foreign object ingestion requirements of § 33.77." The FAA believes that the revised proposal attains the objective of the recommendation. The proposal is adopted with the revisions noted.

Proposal 3-34. Several comments were made on proposed §§ 23.1093 and 25.1093 that did not take into consideration Amendment Nos. 23-15 and 25-36, effective October 31, 1974. Proposals 3-11 and 3-34 proposed only a minor change to make it clear that the requirements of §§ 23.1093(b) and 25.1093(b), concerning ice accumulation caused by the ice and snow expected within the approved flight envelope, cover air inlet system components.

Proposed §§ 23.1093(b), 25.1093(b), 27.1093(b), and 29.1093(b) are modified by inserting the word "operate" in place of the words "function properly" for consistency in terminology with the current §§ 23.1093(b), 25.1093(b), 27.1093(b), and 29.1093(b).

Proposal 3-35. The proposal for § 25.1103(d), concerning turbine engine air duct systems, is related to a proposed amendment to § 25.1103 that is contained in Airworthiness Review Program Notice No. 8 (Notice 75-31). The proposed amendment to § 25.1103(d), contained in Notice No. 3, is therefore deferred until final rule-making action with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 3-35 will be considered at that time.

Proposal 3-36. One commentator suggested that proposed § 25.1121(b) be revised by adding the words "probable" before "leakage" and "hazardous" before "fire". The FAA does not agree. The consequences of leakage from systems carrying flammable fluids can be sufficiently hazardous to warrant the assumption of leakage even if not probable. Also, the FAA regards any fire as being hazardous.

For the reasons given in the discussion relating to Proposal 3-12, proposed § 25.1121(b) has been revised to make it clear that shields used for exhaust system parts are parts of the exhaust system.

Proposal 3-37. One commentator agreed with the proposed amendment to § 25.1123 but preferred to see all APU requirements separately stated rather than combined with the requirements for propulsion engines. The FAA, however, believes that identical requirements should be in the same section unless the applicability needs further clarification. Since no need was shown by the commentator, the proposal is adopted without substantive change.

Proposal 3-38. In response to an inquiry in the explanation of proposed new § 25.1129, several commentators stated that the proposal was covered by proposed § 25.901(c). The FAA agrees and the proposal is withdrawn.

Proposal 3-39. Several commentators stated that proposed § 25.1141(f) should apply only to valves that are essential to the safe operation of the airplane. The FAA disagrees. If any power-assisted valve is used, the flight crew might rely on it and should have an indication of when the valve is in the fully open or fully closed position, or when it is moving between the fully open and fully closed position.

The same commentators noted that an indication that the valve has attained the selected position should be required. For discussion of this comment and revision of new §§ 25.1141(f)(1) and (2), see Proposal 3-13.

Proposal 3-40. Several commentators objected to proposed §§ 25.1145(c), 27.1145(b), and 29.1145(c), concerning groups of ignition switches. The commentators stated that these new requirements were not necessary for turbine engines that do not require continuous ignition. The FAA agrees, since inadvertent movement of the ignition switch would not affect the operation of such an engine once that engine has been started. Accordingly, §§ 23.1145(c), 25.1145(c), 27.1145(b), and 29.1145(c) are revised to except the ignition switches for these engines from the requirement to have a means to prevent inadvertent operation of the group of ignition switches.

Proposal 3-41. The proposed § 25.1195(b), concerning fire extinguisher discharge, is related to a proposed amendment to § 25.1195(b) that is contained in Airworthiness Review Program Notice No. 8 (Notice 75-31). The proposed amendment to § 25.1195(b) contained in Notice No. 3, is therefore deferred until final rule-making action with respect to the related proposal in Notice 75-31. Comments submitted for Proposal 3-41 will be considered at that time.

Proposal 3-42. No unfavorable comments were received on the proposal to amend § 25.1197. Accordingly, the proposal is adopted without substantive change.

Proposal 3-43. A commentator recommended a revision of the first sentence of proposed § 25.1199(b) concerning the location of pressure relief discharges of fire extinguishing agents. The commentator suggested that the discharge end be required to be located to avoid hazard to the airplane rather than damage. The FAA disagrees. The proposal is intended to provide for the consideration of damage such as corrosion that may be caused by the discharge of fire extinguishing agents. The commentator's suggestion would not clearly provide for such necessary consideration.

Proposal 3-44. One commentator questioned proposed § 25.1207. The commentator stated that analysis should not be permitted as the sole method of showing compliance with the fire protection requirements. The FAA agrees that some of the requirements of §§ 25.1181 through 25.1203 may be complied with by analysis alone, while others require other methods of substantiation. Section 25.1207(d) is therefore revised to make clear that unless tests are specifically required in §§ 25.1181 through 25.1203 analysis is an acceptable method of showing compliance.

Another commentator pointed out that proposed § 25.1207(b) as written would preclude the use of the Statham test to determine extinguisher agent concentrations in an actual fire zone, contrary to his understanding that the Statham test method is acceptable. The FAA agrees and proposed paragraph (b) is revised to specify "tests of components," instead of "bench fire tests of components."

Proposal 3-45.. For a discussion of the withdrawal of proposed § 25.1305(a)(9), see Proposal 3-29.

Proposals 3-46 and 2-86. Disposition of Proposal 2-86 (Notice 75-10) to amend § 25.1337(a) was deferred so that it could be considered in connection with Proposal 3-46, also to amend § 25.1337(a).

Two commentators concurred with Proposal 2-86, but believed that a review of other paragraphs of Part 25 affecting APU installations is required. The FAA does not agree. If other requirements are determined to be applicable to APU installations, additional proposals will be made in future rule-making actions. The FAA finds no reason to withhold adoption of these proposals pending such a determination.

No unfavorable comment was received on Proposal 3-46 and the proposal is adopted without substantive change.

Proposals 3-47 and 2-94. Disposition of Proposal 2-94 (Notice 75-10) to revise §§ 25.1549(a), (b), and (c) was deferred so that it could be considered in connection with Proposal 3-47, to amend § 25.1549(d).

One commentator concurred with Proposal 2-94, but pointed out that while it accommodated vertical scale instruments it did not accommodate horizontal scale instruments. The FAA agrees, and § 25.1549 as adopted will provide marking standards appropriate to circular, horizontal, and vertical scale powerplant instruments.

Another commentator believed that the proposal to provide specific requirements for marking vertical tape instruments, to provide for cockpit instrument standardization, is not appropriate for today's turbine engines. The commentator indicated the requirement could produce overlapping markings which could be misleading and, under certain operating conditions, could indicate that an unsafe condition is safe. The commentator recommended that markings for vertical tape engine instruments not be specified because such standardization is not in the best interest of safety. The FAA believes that overlap markings on tape instruments, similar to the overlap markings on round face instruments, will provide an adequate and safe presentation.

No unfavorable comment was received on Proposal 3-47, to amend § 25.1549(d) and the proposal is adopted without substantive change.

Proposal 3-48. Proposed § 25.1557(e) was intended to implement the requirement in Proposal 3-20 and is withdrawn because of the withdrawal of that proposal.

Proposal 3-49. No unfavorable comment was received on the proposal to amend § 25.1585. Accordingly, the proposal is adopted without substantive change.

Proposal 3-50. One commentator objected to the proposed amendments to §§ 27.571 (a) and 29.571(a). The commentator stated that the addition of the language "rotor drive systems between the engines and the rotor hubs" to the parenthetical description of flight structure is misleading and unnecessary. In support, the commentator suggested that the fatigue evaluation of the rotor drive system is accomplished upon compliance with §§ 27.923 or 29.923. The commentator's reply indicates (as was noted in the explanation for the proposals) the need for a clarification that the fatigue evaluation of §§ 27.571 and 29.571 includes portions of the rotor drive system. Sections 27.923 and 29.923 are primarily endurance test requirements, while §§ 27.571 and 29.571 are the fatigue evaluation requirements. It is therefore appropriate to include the rotor drive systems in the parenthetical description of the flight structure that must be included in the fatigue evaluation of §§ 27.571 or 29.571, as applicable.

Accordingly, the proposed amendments to §§ 27.571(a) and 29.571(a) are adopted without substantive change.

Proposal 3–51. One commentator objected to the proposed amendments to §§ 27.901 (c)(1) and 29.901(b)(1)(i) that, if adopted, would require compliance with the engine installation instructions provided under § 33.5(a). The commentator stated that the installation instructions are apparently aimed at field information for the owner and in any case § 33.5 does not require that this information be provided until just prior to engine certification in many cases. The commentator recommended that the requirement should not refer to § 33.5 but to specific engine installation parameters which are essential to proper engine performance and which are exclusively the responsibility of the engine manufacturer.

The installation instructions of § 33.5(a), in general, include a description of the location of mounting attachments and methods of attachment of the engine and engine components. The FAA believes this information is particularly pertinent to rotorcraft type certification. The FAA further believes that the installation instructions will be prepared by the engine type certificate applicant at the early stages of the engine type certification program. The commentator's suggestion that specific engine installation parameters be identified (rather than adopting the proposed reference to § 33.5) could lead to the failure to consider other installation parameters that may be significant to safety. Also see Proposal 3–21.

Proposal 3–52. Two commentators suggested that proposed § 27.923(e) may be subject to misinterpretation but indicated that this was not a problem to them. Proposed § 27.923(e) includes language similar to current § 29.923(b)(2). The FAA believes these requirements should be consistent and therefore believes the wording should be similar to avoid a different interpretation.

Two commentators objected to proposed § 27.923(j) concerning the 30-minute power test for certain multiengine rotorcraft. The commentators indicated that proposed § 27.923(j) is inconsistent with proposed § 27.923(b) since more than 100 hours of testing would be required. The FAA does not believe that the proposed paragraphs are inconsistent. Proposed paragraph (b) would require that the rotor drive system and controls on all rotorcraft be tested for not less than 100 hours, and proposed paragraphs (c) through (e) would merely establish the kinds of tests included in those 100 hours. Proposed paragraph (j), which would apply only to rotorcraft for which the use of 30-minute power is requested, would require testing in addition to the 100 hours.

Another commentator stated that the FAA should not "bother with the change from 'power' to 'torque' as it leads to very confusing wording". The change of language to "torque" and "speed" was proposed because the FAA believes these are the parameters generally used by applicants in conducting the rotor drive system tests. The additional reference in the proposal to power, e.g., the 2½ minute and 30-minute power runs specified in paragraphs (e) and (j), is made to establish the relationship between the torque and speed and the corresponding engine power rating.

A commentator considered the cyclic aspect of testing to be important and suggested that the proposal specify the number and duration of cycles rather than the overall time. The FAA disagrees. The proposal does not change the terms of current § 27.923(f) which provides flexibility in establishing testing intervals (cycles). The FAA is not aware of a problem that would justify changing these minimum test intervals.

The same commentator also believed the proposed test runs at 2½ minute and 30-minute power were inadequate and compared poorly with the test required to qualify the engine under Part 33. The FAA disagrees. As stated in the explanation, the 2½ minute and 30-minute power test in the proposal for a normal category rotorcraft is to demonstrate that the rotor drive system can absorb the torque of engines operating at 2½ minute and 30-minute power. These ratings, however, are not incorporated into the performance requirements as is the case under Part 29, for transport category rotorcraft, and no performance credit is realized from their use. Therefore, the FAA believes the test is adequate under Part 27.

Proposals 3-53 and 2-118. Proposal 2-118 was deferred so that it could be considered with Proposal 3-53 since both proposed to amend § 27.927(b)(2). Proposal 2-118 would change the words "one hour" in § 27.927(b)(2) to "fifteen minutes". In this connection a commentator asked if due consideration had been given to the 30-minute emergency power rating when establishing the time requirement. The 30-minute power is taken into account by the terms of the requirement for test at maximum torque attainable under probable operating conditions.

Two commentators to Proposal 3-53 believed that in proposed § 27.927(b)(2) the word "outputs" should be "inputs". The FAA agrees and the proposal is revised accordingly.

One commentator stated that the 15-minute duration specified in proposed § 27.927(c), concerning operation after loss of oil pressure, should be 5 minutes to bring it into line with the protection time specified in current § 27.861. The FAA does not agree. The 5-minute duration is specified in § 27.861 since the occurrence of a fire normally necessitates immediate descent and landing. Loss of oil pressure in the rotor drive system does not correspondingly necessitate immediate descent and landing. The 15-minute requirement would provide for a reasonable durability of the system following the loss of oil pressure.

Two commentators believed that in proposed § 27.927(c) the term "autorotative conditions" was vague and should be replaced with the term "the low power conditions of autorotative flight". The FAA does not agree. Under autorotative conditions no power is transmitted from the engine to the rotor blades. Therefore a low power condition of the engine would not be applicable.

A commentator believed that the use of the word "torgue" in place of "power" was confusing. The commentator indicated that the proposal could be interpreted to permit a static test since only torque and no rotational speed is specified. The proposal to use the word "torque" was made since the tests are run on the basis of the torque absorbed by the rotors. The torque being absorbed is that produced by the operating engine and transmitted through the rotor drive system.

A commentator stated that proposed paragraph (c) did not consider the design alternative of a back-up oil system. The FAA agrees that compliance by the use of a second oil system after failure of the primary system should be allowed. Proposed §§ 27.927(c) and 29.927(c) are revised accordingly.

A commentator suggested that it should be noted that the drive system need not be in condition for continued operation after the 15-minute test prescribed in paragraph (c). The FAA agrees that compliance with the proposal would be achieved after the 15-minute test was successfully run regardless of the condition of the rotor drive system.

Proposal 3-54. No unfavorable comments were received on the proposal to amend § 27.965. Accordingly, the proposal is adopted without substantive change.

Proposal 3-55. Several commentators to the proposed amendment of §§ 27.1093(b) and 29.1093(b) apparently failed to note the changes made by Amendment Nos. 27-9 and 29-10 (39 FR 35452; October 1, 1974). The proposals intended only to add the language "and its air inlet system" to §§ 27.1093(b)(1) and 29.1093(b)(1) and to restructure both sections to incorporate the added language. For a discussion of a change made to proposed § 27.1093(b), see Proposal 3-34.

Proposal 3-56. One commentator stated that § 27.1121(d), unlike §§ 23.1121(b) and 29.1121(b), did not need the clarification proposed. The FAA agrees that § 27.1121(d) did not use the language "dangerously close" that had been an administrative problem in §§ 23.1121(b) and 29.1121(b). However, beside the desire for consistency among the airworthiness certification parts, the FAA believes that proposed § 27.1121(d) provides a more comprehensive standard and will allow greater design flexibility.

For a discussion of changes made to proposed § 27.1121(d), see Proposal 3-12. No unfavorable comments were received concerning proposed § 27.1121(g) and it is adopted without substantive change.

Proposal 3-57. A commentator objected to proposed § 27.1141(d). The commentator stated that this proposal was not deemed necessary for Part 29 and asked why it was necessary for Part 27. The FAA disagrees that a similar requirement was not deemed necessary for Part 29. Proposed § 29.901(c) that is adopted in this amendment will require a similar consideration for powerplant controls in transport category rotorcraft. Further, the FAA believes that this requirement is necessary for normal category rotorcraft. Many turbine powerplant control systems on normal category rotorcraft are inherently complex. Considering such complexity, the FAA believes that consideration must be given to system redundancy, alternate devices, and duplication of functions in the design of certain turbine powerplant control systems.

Another commentator stated that the proposal to add a new § 27.1141(c) would require position indicators for all powerplant controls and considered this to be an excessive and unnecessary requirement. The FAA disagrees. The proposed new § 27.1141 (c) applies only to powerplant valve controls located in the cockpit. For discussion of the revision of new §§ 27.1141(c)(1) and (2), see Proposal 3-13.

Proposal 3-58. One commentator stated that the proposed changes to §§ 27.1145(b) and 29.1145(c), concerning the prevention of inadvertent operation of each group of ignition switches, would seem to contradict current §§ 27.1145(a) and 29.1145(b). Sections 27.1145(a) and 29.1145(b) require a means to quickly shut off all ignition by the grouping of switches or by a master ignition control. The FAA believes that the means provided to prevent inadvertent operation can be designed so that it will not prevent or adversely affect the ability to quickly shut off all ignition.

See Proposal 3-40 for a discussion of the revision of proposed § 27.1145(b) to provide an exception for turbine engines that do not require continuous ignition.

Proposal 3-59. A commentator stated that the revisions proposed for §§ 27.1305(e) and 29.1305(a)(5), concerning altitude engines, are not needed since the current rules are clear. The FAA believes that, considering the proposed new definition for an "altitude engine" that is adopted as an amendment to § 1.1 in this document, the proposed revisions concerning altitude engines in the airworthiness rules are not needed. The term "altitude engine" that is used in §§ 23.1305(h), 27.1305(e), and 29.1305(a)(5) will include a derated engine as well as a supercharged engine after the amendment to § 1.1. Accordingly, proposed §§ 23.1305(h), 27.1305(e), 29.1305(a)(5) are withdrawn.

Proposal 3-60. No unfavorable comments were received on the proposal to amend § 27.1337(a). Accordingly, the proposal is adopted without substantive change. Also see Proposal 3-18.

Proposal 3-61. For a discussion of a comment concerning § 29.571(a), see Proposal 3-50.

Proposal 3-62. A commentator stated that proposed §§ 29.901(b)(1)(iii) and (c) are redundant and unnecessary. The FAA agrees that proposed § 29.901(b)(1)(iii) is unnecessary, and it is withdrawn. The FAA does not agree that proposed § 29.901(c) is redundant and unnecessary. Experience has shown the need for a failure requirement that is explicitly applicable to powerplant and auxiliary power unit installations.

One commentator stated that considering probable combinations of failures in proposed § 29.901(c) is inconsistent with the overall philosophy of Part 29. However, since the commentator did not state its view of the overall philosophy of Part 29, the FAA cannot respond to this comment.

The commentator suggested that engine rotor disc failures should be excluded from the consideration required by paragraph (c) since the rotorcraft environment is much more complex than in the case of an airplane. Also the commentator asserted that a lower incidence of fatigue failure can be expected in rotorcraft engines than in airplane engines. The FAA agrees and § 29.901(c) is revised to exclude engine rotor disc failures from consideration under that paragraph.

For comments related to the proposed amendment of § 29.901(b)(1)(i), see Proposal 3-51.

Proposal 3-63. No unfavorable comment was received on the proposed deletion of paragraphs (d) and (e) in § 29.903, and the paragraphs are deleted. Also, see Proposal 3-64.

Proposal 3-64. A commentator, while generally agreeing with proposed new § 29.908, objected to its applicability to the entire cooling fan. The commentator stated that there is no service or test history that indicates a need to consider the entire fan. The

FAA believes that the absence of cooling fan failures is due to the requirements of current § 29.1461 which applies to cooling fans that incorporate high energy rotors. In view of the requirements of current § 29.1461 and the fact that there is no service experience of fan failures, the FAA considers that proposed § 29.908 should be revised to be applicable only to cooling fan blade failures. Proposed § 29.908 is revised accordingly.

A commentator stated that loss of cooling may affect the continued safe operation of one or more engines and so prevent continued safe flight. The FAA did not intend to consider the effect of cooling loss but is concerned only with the fragmentation effect of a fan blade failure.

Proposal 3-65. A commentator believed the specification of 15 minutes in proposed § 29.927(c), concerning the loss of rotor drive system oil pressure, was inadequate for category A helicopters which have engine-out capability. Therefore, the commentator indicated, operations are planned over routes where a landing may not be possible within 15 minutes. The intent of the proposal is to enable the pilot to make an autorotative landing after loss of rotor drive system oil pressure and the FAA believes that the proposed 15 minute requirement is adequate for that purpose.

For a discussion of other comments related to proposed § 29.927(c), see the discussion of Proposal 3-53.

Proposal 3-66. A commentator stated that under his interpretation of § 29.965 only a pressure test is required for non-metallic fuel tanks, and he also recommended that slosh testing of non-metallic tanks be added as a requirement. The FAA disagrees. Paragraphs (a), (b), and (c) of § 29.965 apply prescribed pressure tests to all fuel tanks. In addition, § 29.965(d) already applies the slosh test requirement to each tank with large unsupported or unstiffened flat areas, or with other features whose failure or deformation could cause leakage. The proposal is adopted without substanve change.

Proposal 3-67. No unfavorable comments were received on the proposal to amend § 29.991(b). Accordingly, the proposal is adopted without substantive change.

Proposal 3-68. No unfavorable comments were received on the proposal to amend § 29.995. Accordingly, the proposal is adopted without substantive change.

Proposal 3-69. Although there were no unfavorable comments to the proposed amendment of § 29.1093(b) concerning the addition of the inlet system to the consideration required in paragraph (b)(1), the proposal is revised based on a comment to Proposal 3-34. See the discussion for Proposal 3-34.

Proposal 3-70. For a discussion of the revision to § 29.1121(b), see Proposal 3-12.

Proposal 3-71. Although there were no unfavorable comments to proposed § 29.1141 (f), the proposal is revised based on a comment to Proposal 3-13. See the discussion for Proposals 3-13 and 3-57.

Proposal 3-72. For a discussion of proposed § 29.1145(c), see Proposals 3-40 and 3-58.

Proposal 3-73. Two commentators objected to the proposal to amend § 29.1193(e) on the grounds that present fire protection requirements for category B rotorcraft are adequate and that the proposal would place an undue weight and cost burden on category B rotorcraft. The FAA disagrees. Service experience has shown that the fire protection requirements specified in § 29.1193(e) should apply to all category of rotorcraft, especially those that may not be required to have fire extinguishing and fire detection systems. The FAA believes that the increase in cost and weight associated with this requirement is justified by the increment of safety attained. The proposal is therefore adopted without substantive change.

Proposal 3-74. No unfavorable comment was received on the proposal to amend § 29.1195. Accordingly, the proposal is adopted without substantive change.

Proposal 3-75. No unfavorable comments were received on the proposal to amend § 29.1197. Accordingly, the proposal is adopted without substantive change.

Proposal 3-76. No unfavorable comment was received on the proposal to amend § 29.1199, and the proposal is adopted without substantive change. Also, see discussion for Proposal 3-43.

Proposal 3-77. For a discussion of the withdrawal of proposed § 29.1305(a)(5), see Proposal 3-59.

Proposals 3-78 and 2-185. Disposition of Proposal 2-185 (Notice 75-10) to amend § 29.1337(a) was deferred so that it could be considered in connection with Proposal 3-78, which is also a proposal to amend § 29.1337(a). No unfavorable comment was received on either proposal. Accordingly, the proposals are adopted without substantive change.

Proposal 3-79. No unfavorable comments were received on the proposal to amend § 33.15. Accordingly, the proposal is adopted without substantive change.

Proposal 3-80. No unfavorable comments were received on the proposal to amend § 33.17. Accordingly, the proposal is adopted without substantive change.

Proposal 3-81. No unfavorable comments were received on the proposal to amend § 35.17. Accordingly, the proposal is adopted without substantive change.

Proposal 3-82. No unfavorable comments were received on the proposal to amend § 35.35. Accordingly, the proposal is adopted without substantive change.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, and for the reasons stated in Notices 75-10 and 75-19, Parts 1, 23, 25, 27, 29, 33, and 35 of the Federal Aviation Regulations are amended as follows, effective May 2, 1977.

The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A-107.

Amendment 25-41

Airworthiness Review Program
Amendment No. 5: Equipment and Systems Amendments

Adopted: July 11, 1977 **Effective: September 1, 1977**

(Published in 42 FR 36960, July 18, 1977)

SUMMARY: The purpose of these amendments is to update and improve the airworthiness standards applicable to aircraft equipment and systems and to make related changes in the operating rules. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

Adolfo O. Astorga, Airworthiness Review Branch (AFS-910)
Flight Standards Service, Federal Aviation Administration
800 Independence Avenue, SW., Washington, D.C. 20591
Telephone 202-755-8714

SUPPLEMENTARY INFORMATION: These amendments are the fifth in a series of amendments to be issued as part of the Airworthiness Review Program. The following series of amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR citation*
Form number and clarifying revisions	(40 FR 2576; January 14, 1975)
Rotorcraft anticollision lights standards	(41 FR 5290; February 5, 1976)
Miscellaneous amendments	(41 FR 55454; December 20, 1976)
Powerplant amendments	(42 FR 15034; March 17, 1977)

These amendments are based on two Notices of Proposed Rule Making—Notice 75-10 published in the Federal Register on March 7, 1975 (40 FR 10802); and Notice 75-23 published in the Federal Register on May 27, 1975 (40 FR 23048). The amendments based on Notice 75-10 were deferred in the series of amendments titled "Miscellaneous Amendments" so that they could be considered in conjunction with the final disposition of certain proposals in Notice 75-23. The discussions of the comments received for the deferred proposals are included under the heading of the related Notice 75-23 proposals.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notices 75-10 and 75-23.

Two of the proposals of the original Notice concerning rotorcraft anticollision lights (§§ 27.1401 and 29.1401) have been implemented by separate rule-making action, Amendments 27-10 and 29-11, effective February 5, 1976, that were published in the Federal Register on February 5, 1976 (41 FR 5290). In addition, several proposals which were contained in Notice 75-23 are not being dealt with here but will be considered in conjunction with the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975).

DISCUSSION OF COMMENTS

The following discussion is keyed to the like-numbered proposals contained in Notice 75-23.

Proposal 5-1. One commentator objected to the marking (or tagging) requirement in proposed § 23.1301(a)(2), which would require that the marking or tag include identification, function, and operating limitations, on the ground that it would necessitate a multitude of tags on small items of equipment which could interfere with operation of the aircraft or otherwise constitute a hazard. Another commentator contended that the service record does not justify a need for the requirement. Another commentator recommended that this requirement be expanded to require that the marking or tag include information to show that the equipment had been produced under an approved FAA quality control system, or that it had been approved by the FAA for installation on a particular type of aircraft. After further review, the FAA agrees with the first commentator and believes that the proposed marking or tagging requirement should be withdrawn. Accordingly, the requirement in proposed § 23.1301(a)(2) is withdrawn. However, current § 23.1301(a)(2) is amended by deleting the words "if appropriate" for consistency with §§ 25.1301, 27.1301, and 29.1301.

One commentator objected to the requirement in proposed § 23.1301(b) on the ground that it would be extremely difficult, or impossible, in the design of an item of equipment, or of its installation, to provide absolute assurance that it is incapable of interfering with the operation of interfacing equipment under all possible failure conditions. Another commentator stated that the wording of the proposal could be interpreted to mean that fully redundant equipment systems must be installed. The FAA agrees that proposed § 23.1301 (b) would be unnecessarily restrictive, and it is withdrawn. In view of the withdrawal of proposed § 23.1301(b), the paragraphs in § 23.1301, as adopted, have been redesignated.

The proposed revision of the lead-in of current § 23.1301(a) was intended to expand the applicability of that paragraph to cover all optional equipment, consistent with corresponding language in current §§ 25.1301, 27.1301, and 29.1301. One commentator objected because it would require markings on additional items of optional equipment. The FAA believes that the marking of all equipment items contributes significantly to safety by helping to prevent their improper installation and operation, and the lead-in of § 23.1301(a) is revised as proposed.

Proposals 5–21, 5–39, and 5–53 to revise §§ 25.1301(b), 27.1301, and 29.1301, respectively, are withdrawn for the reasons stated herein with respect to proposed § 23.1301.

Proposal 5–2. The deletion of current § 23.1309(a) was proposed because it would have been superfluous if proposed § 23.1301(b) (see Proposal 5–1) had been adopted. Proposed § 23.1301(b) is withdrawn. Consequently, the proposed deletion of current § 23.1309(a) is also withdrawn.

Proposal 5–3. Several commentators questioned proposed §§ 23.1321(a), 25.1321(a), 27,1321(a) and 29.1321(a) (Proposals 5–3, 5–23, 5–42, and 5–56, respectively) concerning the visibility of instruments with a visual indicator for use in flight by any pilot. It was stated that the proposed standard did not adequately provide for instruments that were monitored infrequently during flight as contrasted with instruments more critical to flight safety. With respect to rotorcraft, one commentator also objected on the ground that the space available for mounting instruments was extremely limited. The FAA agrees that priority of instruments and instrument location needs to be more definitive. Therefore, proposed §§ 23.1321(a), 25.1321(a), 27.1321(a) and 29.1321(a) are withdrawn.

Several commentators objected to the phrase "under all cockpit lighting conditions" in proposed §§ 23.1321(e), 25.1321(e) 27.1321(d), and 29.1321(g), contending that it includes everything from lightning to total darkness resulting from complete electrical failure at night. In light of these comments and after further FAA review, proposed §§ 23.1321(e), 25.1321(e), 27.1321(d), and 29.1321(g) are revised to require consideration of all probable cockpit lighting conditions with respect to the visibility of malfunction indicators.

For another comment related to proposed § 23.1321(e), see Proposal 5–23.

Proposal 5–4. One commentator objected to proposed § 23.1323 on the ground that the resulting economic burden to aircraft owners is unwarranted. Another commentator objected to proposed § 27.1323(a) contending that it was unnecessary to calibrate the airspeed indicating instrument. The FAA disagrees with these comments. A requirement for the calibration of the airspeed indicating instrument is necessary to ensure that excessive error is not introduced into the system by the installation of a replacement instrument after the aircraft goes into service. In addition, the FAA believes that although the proposed calibration standards differ from the current standards, they impose little, if any additional burden in showing compliance.

Another commentator (who concurred with the intent of the proposal to revise § 25.1323) questioned whether the allowable error, in proposed § 23.1323(b), should be expressed in terms of calibrated airspace rather than indicated airspeed and whether the airspeed ranges specified in proposed §§ 23.1323(b)(1) and (b)(2) were unnecessarily severe accuracy requirements. The FAA agrees that the error allowed by proposed § 23.1323(b) should be expressed in terms of calibrated airspeed to be in accord with normal practices. However, the FAA believes that the airspeed ranges in proposed §§ 23.1323(b)(1) and (b)(2) are needed to encompass the airspeed limitations in proposed § 23.1545. The FAA also believes that, as a practical matter, the accuracy requirements in proposed § 23.1323 are not significantly more restrictive than the current requirements.

Accordingly, § 23.1323 is revised as proposed, except that the term "indicated airspeed" in paragraph (b) is changed to "calibrated airspeed."

Proposal 5-5. One commentator objected to the proposal to add a new § 23.1325(d), which would be identical to the standard required by § 25.1325(e), on the ground that general aviation airplanes should not be required to conform to transport category airplane standards. A key function of the altimeter system is to enable the pilot to maintain his assigned or required altitude during flight for the purpose of maintaining vertical separation from other aircraft. There is therefore a need for altimeter system accuracy for all aircraft.

Another commentator stated that the proposal would place accuracy requirements on static pressure systems that are more stringent than the requirements proposed for airspeed indicating system in Proposal 5-4. The commentator stated that, under Proposal 5-4, a 5-knot error at 100 knots would be acceptable and this corresponds to an altitude of more than 30 feet which would not be acceptable under proposed § 23.1325(d). The commentator suggested that the proposed altitude error tolerance of ±30 feet (per 100 knots speed) be increased to ±50 feet. The FAA disagrees with the commentator's suggestion. The proposed standard is identical to the standard required for transport category airplanes, which has been administered without difficulty in the past.

Proposal 5-6. One commentator objected to the proposal to amend § 23.1327 on the ground that it would allow an indefinite amount of interference, which would confuse the pilot. The FAA believes that the placard that would be required by proposed § 23.1327(c) would serve to alert the pilot to the fact that certain electrical loads, when switched on, cause excessive deviations of the magnetic nonstabilized direction indicator. The commentator further stated that if an additional magnetic direction indicator (having a deviation less than 10 degrees) is installed, there would no longer be a need for the magnetic nonstabilized direction indicator. The FAA agrees that an additional magnetic nonstabilized direction indicator is not a practical alternative, and proposed § 23.1327 is revised to delete that alternative. However, the FAA believes that the proposed exception is appropriate for those instances in which a magnetic stabilized direction indicator or gyroscopic direction indicator is installed along with a magnetic nonstabilized direction indicator. The commentator also contended that the gyroscopic direction indicator alternative is not a practical solution because it must be reset frequently, thus increasing the pilot's workload. The FAA does not believe that the need to periodically reset the gyroscopic direction indicator adds significantly to the pilot's workload. Finally, this commentator stated that proposed § 23.1327(c) would allow interference that is contrary to current §§ 23.1327(a) and 23.1301(a)(4). With respect to current § 23.1327(a), the FAA believes the comment is valid, and that paragraph is revised for clarification. In view of this change, the requirements in current § 23.1327(a) and proposed § 23.1327(b) are combined into § 23.1327(a), and proposed § 23.1327(c) is redesignated § 23.1327(b). With respect to current § 23.1301(a)(4), the FAA does not believe the comment is valid, since the system consisting of a magnetic nonstabilized direction indicator and either a magnetic stabilized type or a gyroscopic type would meet that requirement.

Another commentator suggested that short term deviations (up to 30 seconds), caused by switching transients should be allowed without placarding the installation. The FAA does not agree. In general, the duration of switching transients is so short that their effect on the magnetic nonstabilized direction indicator is negligible. However, if switching does result in deviations exceeding 10 degrees for substantial intervals, the FAA believes the pilot must be so informed (by placarding) to avoid being misled or confused.

Proposal 5-7. The proposal to amend § 23.1329 is similar to proposals to amend §§ 25.1329 and 29.1329 and to the proposal to add a new § 27.1311 (Proposals 5-24, 5-58, and 5-41, respectively). Other related proposals affecting §§ 25.1329, 27.1329, and 29.1329 were set forth in Airworthiness Review Notice No. 2 (Notice 75-10) as Proposals 2-84, 2-129, and 2-184, respectively, and their disposition was deferred for consideration with Proposals 5-24, 5-41, and 5-58 respectively. The FAA is still reviewing all of these proposals, which concern automatic pilot systems. To avoid delaying the adoption of the amendments contained in Airworthiness Review Program Amendment No. 5, the disposition of these proposals has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7; Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975).

Proposals 5-8 and 2-37. For comments related to the proposal to revise § 23.1335, and for an explanation of the revisions to proposed § 23.1335, see Proposal 5-27.

Disposition of Proposal 2-37 to delete § 23.1335 (Notice 75-10 was deferred so that it could be considered in connection with Proposal 5-8. Proposal 2-37 is being withdrawn in view of the adoption, with revisions, of Proposal 5-8.

Proposal 5-9. One commentator suggested that the phrase "not used solely for starting engines" in proposed § 23.1351(f) could be misinterpreted. The explanation in the notice stated that the proposal was intended to prevent damage to the aircraft's electrical system if reverse polarity or reverse phase sequence of the external power source occurred. Therefore, as suggested by the commentator, proposed §§ 23.1351(f), 25.1351(c), 27.1351(e), and 29.1351(d) (designated as § 29.1351(c)) are clarified to require protection if "external power can be electrically connected to equipment other than that used for engine starting."

One commentator objected to proposed §§ 27.1351(e) and 29.1351(d) on the ground that they do not provide a reasonable limit on the extent to which one has to go to ensure that a reverse polarity connection cannot be made. The FAA believes that the proposals are clear and unambiguous as to their intent and as to what is required. The FAA believes that a more detailed requirement would be unnecessarily restrictive.

One commentator objected to proposed § 25.1351(c) on the ground that it does not cover every external power condition that should be protected against, and that its objective is already covered by current regulations on electrical systems and equipment. The purpose of the proposal for protection against those hazardous conditions involving external power that have occurred in service. With respect to the current regulations on electrical systems and equipment, they are not sufficiently specific to adequately deal with the subject matter of these proposals.

Proposal 5-10. No favorable comments were received on the proposed revisions of §§ 23.1353(b)(1), 25.1353(c)(1)(i), 27.1353(b)(1) and 29.1353(c)(1)(i) and those sections are amended as proposed.

Several commentators recommended that proposed §§ 23.1353(g), 25.1353(c)(6), 27.1353(g) and 29.1353(c)(6), be revised to apply to lead-acid batteries in addition to nickel cadmium batteries and to apply to batteries not used for starting as well as those used for starting. The FAA does not agree. There is no history of hazardous effects on structure or essential systems caused by excessive heating of lead-acid batteries. With respect to nickel cadmium batteries, excessive heating has only been associated those batteries that were being used for starting.

One commentator stated that the content of proposed § 23.1353(g) is already covered by the first sentence of § 23.1353(b), which states that "safe cell temperatures and pressures must be maintained during any probable charging and discharging condition". The FAA does not agree. That requirement covers the normal range of battery operating conditions and does not provide for the thermal runaway condition that has occurred in service with nickel cadmium batteries.

Another commentator contended that the temperature generated by a short circuit cannot be foreseen accurately and that it would be more advisable to take measures to prevent such short circuits instead of trying to counter their effects. The FAA believes that the temperature (and heat) generated by a short circuit can be determined with sufficient accuracy for design purposes. In addition, the FAA knows of no practical means that would prevent the internal short circuits of the battery that are caused by thermal runaway.

One commentator objected to proposed § 27.1353(g) because he considered that the proposal could be construed to require protection against damage that would not be hazardous. The FAA does not believe that the proposed language has that connotation. The intent of the term "hazardous effect" is to exclude non-hazardous damage that may occur.

One commentator suggested that warning systems, when provided, that alert the crew to take corrective action should be considered in determining the degree of thermal protection required for the surrounding structure. The FAA does not agree. Thermal protection is needed in case the warning is not observed by the crew, or the warning system itself fails.

Proposed §§ 23.1353(g), 25.1353(c)(6), 27.1353(g) and 29.1353(c)(6) are adopted without substantive change; however, they are designated as §§ 23.1353(f), 25.1353(c)(5), 27.1353(f), and 29.1353(c)(5), respectively.

Proposal 5-11. No unfavorable comments were received on the proposal to revise § 23.1357(b). Accordingly, the proposal is adopted without substantive change.

Proposal 5-12. No unfavorable comments were received on the proposal to amend § 23.1361(b). Accordingly, the proposal is adopted without substantive change.

Proposal 5-13. Several commentators objected to the increase in the anticollision light field of coverage requirement in the proposal to amend § 23.1401 on the ground that a light meeting the proposed requirement would be more expensive. One commentator contended that two anticollision lights would probably be needed to meet the proposed requirement, whereas only one was necessary to meet the current requirement in many instances. The FAA believes that the increased field of coverage can be attained with presently available anticollision lights by simply replacing the lens with another which redistributes the light output. The cost of the modified anticollision light would be about the same as that of those now in use. With regard to the need for two lights, the FAA believes that a single anticollision light that can be located on an airplane to meet a ±30 degree coverage requirement without exceeding obstructed-visibility limits will in most instances meet the ±75 degrees coverage requirement without exceeding those limits.

One commentator objected on the ground that increasing anticollision light coverage does not improve safety in the air rescue situation, since normal crash landing techniques call for disabling all electrical power and the hazards associated with reapplying power to the anticollision lights outweight the benefits. The FAA disagrees. The restoration, or continuation, of electrical power is not hazardous in all situations. The commentator further stated that position lights make the airplane visible to the control tower from directly below, and that, with the increased coverage requirements, the obstructed-visibility limits should be increased proportionately. The FAA believes that the intensity of position lights in the 30 to 75 degree range is small compared to the proposed anticollision light standards, and would be ineffective. With regard to the obstructed-visibility limits, the FAA believes that the present limits can still be met with anticollision lights having the increased field of coverage. The commentator also contended that it is likely the proposed increase in anticollision lights field of coverage could preclude compliance with the requirement that the crew's vision be unimpaired. While the FAA believes that an increase in field of coverage requirements for rotorcraft anticollision lights even at reduced intensity levels would adversely affect crew vision because of objectionable multiple reflections in the cockpit from the rotor blades, the FAA does not believes that redistribution of the light emitted by anticollision lights on airplanes to cover ±75 degrees instead ±of 30 degrees would adversely affect the crew's vision.

In response to the proposal to amend § 25.1401, two commentators suggested that any proposal concerning anticollision lights should be discussed with the International Civil Aviation Organization (ICAO). However, the proposals as adopted will provide the same color requirement as the international standard. With regard to field of coverage, which is not an international standard but is set forth in an ICAO acceptable means of compliance, the adopted field of coverage requirement would meet that acceptable means

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of compliance. The FAA plans to propose a similar change in the ICAO field of coverage acceptable means of compliance.

Accordingly, the proposals to amend §§ 23.1401 and 25.1401 are adopted without substantive change.

Proposal 5-14. For comments related to the proposal to add a new § 23.1438, and for an explanation of revisions made to proposed § 23.1438, see Proposal 5-33.

Proposal 5-15. For comments related to the proposal to add new §§ 23.1447(c) and (d), and for an explanation of the revisions made to proposed §§ 23.1447(c) and (d), see Proposal 5-34.

Proposal 5-16. For comments related to the proposal to add a new § 23.1450, and for an explanation of the revisions made to proposed § 23.1450, see Proposal 5-35.

Proposal 5-17. One commentator suggested that proposed § 23.1461(b)(2) be expanded to require demonstration of satisfactory overspeed and overtemperature margins, establishment of safe fatigue lives, and a fault analysis to show freedom from defects such as burst due to shaft failure and failure due to undetected loss of cooling air. The FAA believes that proposed § 23.1461(b) adequately deals with overspeed and overtemperature conditions and the term "malfunctions" in proposed § 23.1461(b) includes the "defects" mentioned by the commentator. With regard to establishing safe fatigue lives, the FAA does not believe that the need for such a requirement has been demonstrated. For other comments related to this proposal, see Proposal 5-38.

The proposal to add a new § 23.1461 is adopted without substantive change.

Proposal 5-18. The FAA is currently still reviewing the proposals to amend §§ 23.1545, 27.1545, and 29.1545, concerning marking requirements for airspeed indicators. To avoid delaying the adoption of the amendments contained in Airworthiness Review Program Amendment No. 5, the disposition of these proposals has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975).

Proposal 5-19. A commentator recommended that proposed § 23.1547(e) be revised by inserting the words "the operation of" before the words "electrical equipment" to be consistent with the language in Proposal 5-6. The FAA agrees, and proposed § 23.1547(e) is revised accordingly. The commentator further suggested that the placard be required to state "which conditions, or combination of conditions" rather than "which electrical loads, or combination of loads" because deviation is not solely related to electrical loads, and to state the maximum deviation that occurs for those conditions (or combination of conditions) which cause a deviation of more than 10 degrees, so that the pilot is informed of the maximum expected error. The FAA believes that the proposed language covers the sources of excessive deviation that are allowed. With regard to the maximum deviation, the FAA believes that in view of the placarding requirements proposed, a requirement concerning maximum deviation is unnecessary.

Proposals 5-20 and 2-63. Several commentators objected to the provision in proposed § 25.831(e) (Proposal 5-20) that would require a means for independent control of both temperature and quantity of ventilating air in each compartment or area occupied by crewmembers.

In light of the comments received, and after further review, the FAA believes that with respect to crewmember compartments or areas which are ventilated by air interchange with other compartments or areas, a requirement to provide independent control of ventilating air temperature and quantity would impose a burden of complexity and cost not commensurate with its probable contribution to safety. However, with respect to those crewmember compartments and areas which are not ventilated by air interchange with other compartments or areas under all operating conditions, the FAA believes that a means for independent control of ventilating air temperature and quantity must be provided for the occupants to ensure that their ability to perform safety-related functions is not impaired. Proposed § 25.831(e) is revised accordingly.

One commentator recommended that the 800 cubic feet specified in proposed § 25.831(f)(1), and the 5 degrees F. specified in proposed § 25.831(f)(2), be revised to 1100 cubic feet and 10 degrees F., respectively. This commentator contended that a 1100 cubic-foot limit would not affect safety adversely, and that a 10 degree F. temperature differential between flight crew and passenger compartments would not contribute significantly to crew or passenger discomfort. The FAA does not have sufficient information at the present time to justify relaxing the current requirement to the extent recommended by the commentator.

One commentator suggested that the temperature and ventilation controls referred to in proposed § 25.831(f)(3) should be accessible to both pilots. The FAA agrees, and proposed § 25.831(f)(3) is revised to require that the temperature and ventilation controls be accessible to the flight crew.

Disposition of Proposal 2-63 to amend § 25.831 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 5-20. Proposal 2-63 is withdrawn in view of the adoption, with revisions, of Proposal 5-20.

Proposal 5-21. For comments related to proposed § 25.1301(b) and for the withdrawal of proposed § 25.1301(b), see Proposal 5-1.

Proposal 5-22. The proposed changes to §§ 25.1309(a) and (e) with respect to inserting the word "chapter" in place of "subchapter" were also proposed for § 27.1309(a) and §§ 29.1309(a) and (d) (Proposals 5-40 and 5-55, respectively).

Several commentators objected to the proposed change from "subchapter" to "chapter" because it would broaden the scope of the requirement to include equipment, systems, and installations required by the subchapters dealing with various operating rules. One commentator contended that the proposal would require that equipment prescribed in an operating subchapter be designed and installed in each aircraft in order to obtain a type certificate. In the light of these comments, and after further review, the FAA believes that the proposed change of the word "subchapter" to "chapter" in §§ 25.1309(a) and (e), 27.1309(a) and 29.1309(a) and (d) would impose an unreasonable burden on the aircraft manufacturer. Accordingly, this proposed change has not been made.

Two commentators objected to proposed § 25.1309(b)(1) on the ground that the added provision dealing with the loss of all propulsive power is already adequately covered in present § 25.671(d), and that the occurrence of any failure condition which would preclude controlled flight to an emergency landing after loss of all propulsive power would have to be "extremely improbable" and this cannot be achieved. The FAA agees, and proposed § 25.1309(b)(1) is withdrawn.

One commentator objected to proposed § 25.1309(b)(2) on the ground that "operational or performance capability", without qualification, is not a matter for safety regulation. In the light of this comment, and after further consideration, the FAA believes that the phrase "operational or performance capability of the airplane" could be misinterpreted and could cause difficulties in administering the requirement. Therefore, the FAA believes that the language in the current rule should not be changed in this regard. In addition, other commentators noted that the phrase "or the ability of the crew to cope with adverse operating conditions" in current § 25.1309(b)(2) had been omitted from proposed § 25.1309(b)(2) without explanation, and recommended that it be restorted as necessary for safety. The FAA agrees. The phrase was inadvertently omitted from the proposal. Accordingly § 25.1309(b)(2) as adopted retains the language in current § 25.1309(b)(2), except that the phrase "result in injury to the occupants, or" is deleted.

One commentator objected to proposed § 25.1309(d) contending that the method of compliance set forth in paragraph (d), which is applicable to paragraph (b), mandates unreasonably burdensome procedures. The requirements objected to by the commentator are contained in current § 25.1309. The FAA does not believe that requiring compliance with those provisions is unreasonably burdensome. Analyses along the lines prescribed in proposed § 25.1309(d) are being conducted by some manufacturers on a voluntary basis.

One commentator recommended that the term "flight simulator" in proposed § 25.1309(d) be changed to "simulator" to all the use of simulators other than flight simulators. The FAA agrees, and proposed § 25.1309(d) is revised accordingly.

One commentator objected to proposed §§ 25.1309(e) and (d) because they are less stringent than the present requirements, which call for an analysis, and tests where necessary, showing that systems, controls, and associated monitoring and warning means are designed "so that crew errors that would create additional hazards are improbable". As pointed out in the explanation for Proposal 5-22, the FAA has concluded that requiring a showing of compliance with present § 25.1309(d) is unreasonably burdensome. In particular, the FAA believes that it is not practicable to quantify the probability of crew errors. The FAA believes that the requirement, "* * * to minimize crew errors which would create additional hazards", in proposed § 25.1309(c) would provide an adequate level of safety. Accordingly, proposed § 25.1309(c) is adopted without substantive change and the lead-in of § 25.1309(d) is amended to delete the reference to paragraph (c).

The proposed changes to §§ 25.1309(e) and (f) with respect to the two-engine-inoperative condition on aircraft with three engines are substantively identical to the proposed changes to §§ 29.1309(d) and (e) (Proposal 5-55). One commentator objected to proposed §§ 25.1309(e)(3) and (f), and proposed §§ 29.1309(d)(3) and (e), on the ground that they do not provide adequate guideance as to which loads are required during the proposed two-engine-inoperative condition on aircraft with three engines. This commentator recommended that the term "flight safety loads" be used instead of "essential loads" for that condition. The FAA does not agree. The FAA believes that proposed §§ 25.1309(f) and 29.1309(e) are clear in that the monitoring of power loads is allowed in those circumstances and loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with three or more engines. One commentator objected to the proposed two-engine-inoperative condition on aircraft with three engines on the ground that it would impose a requirement for an unreasonable amount of power, in that both units of dual systems would be required to operate during that condition. The FAA disagrees. The procedure set forth in proposed §§ 25.1309(f) and 29.1309(e), which would apply to the two-engine-inoperative condition on three-engine aircraft, would allow the monitoring of one unit of a dual system in those circumstances. Another commentator objected to proposed § 29.1309 (d)(3)(ii) contending that the requirement was unreasonable for rotorcraft since they cannot maintain flight with only one third of installed power. The FAA does not agree that the requirement is unreasonable for rotorcraft. The proposal would ensure that at least those power loads necessary for controlled descent to a safe landing are supplied for the two-engine-inoperative condition on a three-engine rotorcraft. Accordingly, proposed §§ 25.1309(e)(3) and (f), § 29.1309(d)(3) and the proposed change to § 29.1309(e) are adopted without substantive change.

Proposal 5-23. For a discussion of the comments related to proposed § 25.1321(a) and the withdrawal of that proposal, see Proposal 5-3.

With regard to proposed § 25.1321(e), one commentator suggested that it be revised to apply only to those instruments required under current §§ 25.1303 and 25.1305. The commentator stated that the special lighting provisions that would be required for optional equipment by proposed § 25.1321(e) could be distracting under certain emergencies and could create unnecessary loads on the available power supply. The FAA does not believe that a distinction in this regard is warranted between required and optional instruments. The FAA believes that if a malfunction indicator has been provided for the crew it should be effective under all probable cockpit lighting conditions.

For other comments related to Proposed § 25.1321(e), see Proposal 5-3.

Proposals 5-24 and 2-84. The disposition of the proposals to amend § 25.1329 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-7.

Proposals 5-25 and 2-85. Several commentators objected to the proposed deletion of the words "or adjacent to" in current § 25.1331(a)(1) contending that it would restrict flexibility in design and that an integral power failure warning would not necessarily increase warning reliability. The FAA believes that a power failure warning device incorporated within the instrument itself, as opposed to an external device, is more likely to be noticed by the pilot, and would be less vulnerable to wiring or connector failures that may result in loss of the warning function.

One commentator suggested that proposed § 25.1331(a)(3) should apply only to those instruments that present primary navigation data, since navigation is conducted primarily with reference to such instruments and duplication of warning on secondary navigation instruments does not necessarily improve warning reliability. The FAA believes that the instruments covered by proposed § 25.1331(a) are all "primary" in the sense implied by the commentator.

Several commentators, referring to proposed § 25.1331(a)(3), stated that the additional mechanisms and devices necessary to meet this requirement would complicate the design of the instrument to the extent that its reliability would be degraded. The FAA believes that a properly designed warning system would not significantly reduce instrument reliability. Instruments having such warning systems have performed reliably in service.

Several commentators contended that a practicable design meeting proposed § 25.1331(a)(3) is not within the state of the art and that in some instances a triple system, with comparators to monitor and compare signals, would be required. The FAA's intent to require no more than a single system for failure warning. Compliance could be shown, in general, without comparators. Such systems are in use today and are well within the state of the art.

One commentator suggested that the visual warning system that would be required by proposed § 25.1331(a)(3) would tend to reduce or eliminate the sound safe practice of pilots cross-checking instruments to authenticate the information presented. The FAA disagrees. The FAA does not believe that the proposed rule would affect the pilot's cross-checking procedures. In addition, the FAA believes that the warning system would reveal unsafe conditions more effectively and, in some instances, would warn of unsafe conditions that cross-checking would not detect.

Accordingly, the proposed change to § 25.1331(a)(1) and the proposed new § 25.1331 (a)(3) are adopted without substantive change.

Disposition of Proposal 2-85 to revise § 25.1331(a)(2) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 5-25. No unfavorable comments were received on the proposal to revise § 25.1331(a)(2); however, the phrase "provided that instrument operation is maintained" is deleted from proposed § 25.1331 (a)(2) since it is superfluous and could be confusing.

Proposal 5-26. One commentator objected to proposed § 25.1333(b), contending that an instrument display essential to the safety of flight should not have to be switched on when needed. Before an instrument can be switched on, the pilot must first recognize the problem, decide what to do, and then act. The result, the commentator stated, is a time delay that cannot be tolerated at certain critical points in flight, such as immediately after takeoff, and immediately before landing, especially during instrument flight conditions. Another commentator stated that crew action should be allowed for the purpose of restoring power supplies, or selecting an alternative information source, or the like, provided that it is not necessary to do so immediately.

In the light of these comments, and after further review, the FAA believes that this proposal may affect safety adversely. Accordingly, proposed § 25.1333(b) is withdrawn. The proposed editorial change to § 25.1333(a) is adopted.

Proposal 5-27. One commentator objected to proposed § 25.1335 on the ground that mode indication other than mode selector switch position would be impractical and too costly a retrofit. The FAA notes that the proposed requirement would apply only to airplanes for which an application for a type certificate is filed after the effective date of this amendment. Consequently, no retrofit is required. The commentator further stated that the probable complexity of the proposed mode indication device could detract from the reliability of the system and that systems already fitted with the proposed mode indication device have not proven to be 100 percent foolproof. With regard to the complexity of the mode indication device, the FAA does not believe that systems now fitted with the proposed mode indication device have suffered a significant loss in reliability. In addition, the proposed mode indication device would greatly increase the probability that the current mode of operation is properly indicated to the flight crew.

One commentator criticized the proposed phrase "independent of the mode selector switch" because it would tend to dictate design. Another commentator objected to the same phrase on the ground that it does not ake into account modern panels which incorporate illuminated mode indications that give positive indication of the selected mode, but are not independent of the mode selector switch since they are incorporated in it. The FAA agrees with these comments. The phrase "independent of the mode selector switch" is deleted from proposed § 25.1335 and another sentence is added thereto reading "Selector switch position is not acceptable as a means of indication."

One commentator objected to proposed § 23.1335 on the ground that some flight director systems are designed so that the position of the mode selector switch is adequate for mode indication. The FAA knows of no flight director system in which the position of the mode selector switch constitutes a reliable indication of the current mode of operation. Service experience has shown that the two do not necessarily agree. This commentator also stated that the proposed requirement is not practical for small airplanes and is not consistent with requirement that apply to other systems on small airplanes. The FAA believes that the hazards associated with incorrect indication of the flight director system's mode of operation warrant the proposed requirement.

Proposal 5-28. For comments related to the proposal to add a new § 25.1351(c), see Proposal 5-9.

Several commentators stated that proposed §§ 25.1351(d) and 29.1351(c) do not conform to the special condition on which they were based, since they would require the aircraft to operate safely for 5 minutes without normal generator or battery power, whereas the special condition allowed the use of battery power. The FAA agrees that proposed §§ 25.1351(d) and 29.1351(c) should be revised for consistency with recently issued special conditions. The proposals are therefore revised by adding, after the word "power" in the first sentence, the parenthetical phrase "(electrical power sources excluding the battery)".

One commentator stated that §§ 25.1351(d) and 29.1351(c) were unreasonable in that they would require compliance at the maximum certificated altitude, with critical type fuel, and after loss of electrical power, which is a combination that has not occurred in service. The FAA believes that this set of conditions could exist in service, and that it must be considered in the interests of safety. One commentator suggested that the phrase "including a wire bundle or junction box fire" in proposed §§ 25.1351(d)(1) and 29.1351(c)(1) be deleted since these are not "single" malfunctions. The FAA does not agree that they should be deleted. The FAA believes that the occurrence of a fire in a wire bundle or in a junction box should be considered in this context as a single event or malfunction, even though it may result in several circuit failures.

One commentator suggested that proposed §§ 25.1351(d) and 29.1351(c) should provide for continued flight after the specified 5 minute interval, The recommended change is beyond the scope of the notice. In addition, the FAA does not have sufficient information at the present time to justify such a requirement.

Another commentator questioned whether engine thrust reduction and descent, or engine(s) flameout, descent, and subsequent engine restart at a reasonable altitude, would meet the requirements of the proposed rule. The FAA believes that proposed § 25.1351(d) provides for the situation described by the commentator as long as the airplane can be operated safely.

One commentator objected to proposed § 29.1351(c), contending that the requirement was unnecessary for rotorcraft and would result in the introduction of electrical systems of unnecessary complexity and increased likelihood of mismanagement. The FAA does not agree. The loss of normal generator power is potentially hazardous in all transport category aircraft and must be considered in electrical system design. As to the effect on electrical system complexity and the probability of mismanagement, the FAA has not observed a significant increase in complexity or cases of mismanagement on aircraft that have already been required to comply under a special condition.

Accordingly, proposed §§ 25.1351(d) and 29.1351(c) (designated as § 29.1351(d) for consistency with § 25.1351) are adopted with the revision discussed herein.

Proposal 5-29. For comments related to proposed §§ 25.1353(c)(1)(i) and 25.1353(c)(6) see Proposal 5-10.

Proposal 5-30. For comments related to the proposal to amend § 25.1401 see Proposal 5-13.

Proposal 5-31. One commentator objected to proposed § 25.1421(a) on the ground that since a megaphone is not required to be designed to withstand the ultimate inertia forces specified in § 25.561(b)(3), the airframe manufacturer cannot guarantee that a megaphone will perform its function after being subjected to those forces. The FAA agrees that the requirement of proposed § 25.1421 that "the megaphone be so protected that it will perform its function after being subjected to the ultimate inertia forces specified in § 25.561(b)(3)" is too restrictive in the absence of appropriate design standards for the megaphone itself. Accordingly, proposed § 25.1421(a) is revised to read, "If a megaphone is installed, a restraining means must be provided that is capable of restraining the megaphone when it is subjected to the ultimate inertia forces specified in § 25.561(b)(3)."

In addition, the FAA notes that current § 25.1561(b) requires that each location, such as a locker compartment, that carries life saving equipment (which includes megaphones) must be marked accordingly. Proposed § 25.1421(b) would add little to that requirement, and could raise questions about the meaning of § 25.1561(b) with respect to other life saving equipment. For these reasons, proposed § 25.1421(b) is withdrawn.

Proposal 5-32. Several commentators objected to proposed § 25.1435(a)(2), contending that pressure and fluid quantity gages are not necessary for all hydraulic systems. Another commentator stated that the proposal specifies a design detail rather than a requirement and would rule out other displays such as digital callouts. After further review, the FAA believes that pressure and fluid quantity gages are not needed for all hydraulic systems covered by proposed § 25.1435(a)(2). Indicating means other than gages, including warning lights, may be adequate for some systems. Accordingly, the lead-in of proposed § 25.1435(a)(2) is revised to require "a means to indicate" instead of a gage, for system pressure and for fluid quantity.

No favorable comments were received concerning proposed § 25.1435(a)(2)(i) and it is adopted without substantive change.

One commentator suggested that the malfunctions referred to in proposed § 25.1435 (a)(2)(ii) be limited to those associated with low fluid pressure or level. The FAA does not agree. An indicating means for system pressure and fluid quantity would aid the pilots in detecting malfunctions other than low pressure or low fluid quantity. Proposed § 25.1435(a)(2)(ii) is adopted without substantive change.

One commentator stated that the value of 125 percent in proposed § 25.1435(a)(4) was unrealistic and recommended a value of 133 percent. The FAA disagrees. The 125 percent value is in the current rule and the FAA believes that it is appropriate. Proposed § 25.1435(a)(4)(ii) is adopted without substantive change.

No unfavorable comment was received concerning proposed § 25.1435(a)(7) and it is adopted without substantive change.

One commentator suggested that proposed § 25.1435(a)(8) should be revised to take into account the hazardous effects of system failures due to abnormally high temperatures which may occur under certain fault conditions. The FAA does not have sufficient information at the present time to justify such a requirement. Proposed § 25.1435(a)(8) is adopted without substantive change.

Proposal 5-33. One commentator stated that if the term "components" in proposed §§ 25.1438(a) and (b) included all parts of the system it would not be compatible with other sections of Part 25, which use the term "elements". The FAA intended that the term "components" include all parts of the system. Therefore, in order to be consistent with current § 25.1435, which uses the term "elements", that term is substituted for the term "components" in proposed §§ 25.1438(a) and (b).

Another commentator recommended that the 1.5 factor in proposed § 25.1438(a) be reduced to 1.33 to be consistent with current § 25.365(d), which deals with pressurized cabin loads. The FAA does not agree. The FAA does not believe that the factors specified for pressurized cabin loads are appropriate for pressurization system elements. These elements are move comparable to hydraulic system elements for which a 1.5 factor is prescribed in current § 25.1435(a)(1). Proposed § 25.1438(a) is adopted without substantive change.

One commentator questioned the need to specify a higher burst pressure for pneumatic systems than for pressurization systems, contending that pneumatic systems do not necessarily operate at higher pressure and that some are derived from pressurization systems. The FAA's experience has been that pneumatic systems in airplanes are operated at higher pressures, even when a common pressure source is provided for both pneumatic and pressurization systems.

One commentator objected to the provision in proposed § 25.1438(b) requiring a burst pressure test of 4.0 times maximum normal operating pressure, contending that the industry has historically designed and tested pneumatic systems to a burst pressure of 3.0 times maximum normal operating pressure and that service experience over millions of flight hours has proven the integrity of those systems. Another commentator pointed out that pneumatic deicer boots in general use today cannot sustain a pressure of 4.0 times the maximum normal operating pressure. The FAA agrees with these comments, and proposed § 25.1438(b) is revised to specify a burst pressure of 3.0 times maximum normal operating pressure.

Two commentators recommended that the 4.0 factor in proposed § 25.1438(b) be reduced selectively in particular circumstances, contending that a lower factor might be acceptable for certain materials, or when adequate fatigue testing has been done or service experience supports it. The FAA believes that this recommendation (insofar as it would be applicable to a 3.0 burst pressure factor) may have merit but has insufficient data at the present time upon which to base such lower factors.

Another commentator suggested that the 1.5 factor in proposed § 25.1438(b) should be increased to monitor the effects of manufacturing techniques. The FAA does not agree. These effects are monitored by means of FAA's quality control requirements, as set forth in Part 21.

One commentator suggested revision of proposed § 25.1438 to allow the use of analysis, or a combination of analysis and test, as an alternative method of compliance to eliminate unnecessary testing. The FAA agrees that there are instances where an analysis, or a combination of analysis and test, may be equivalent to a test under proposed § 25.1438(a) or (b). Accordingly, a new § 25.1438(c) is added to provide this alternative.

Proposal 5-34. One commentator objected to the provision in proposed § 25.1447 (c)(1) which would require that oxygen dispensing units be automatically presented before the cabin pressure altitude exceeds 14,000 feet, contending that long-standing FAA policy has been that the altitude for automatic presentation should be 15,000 feet and service experience over the last 16 years has not shown a need to reduce that altitude. The commentator further stated that the flight crew is given a warning when or before the cabin pressure altitude reaches 10,000 feet and is therefore alerted (in the event of a gradual increase in cabin pressure altitude) to the need for appropriate action either to maintain a safe cabin pressure altitude or manually deploy the dispensing units. Another commentator suggested that the presentation altitude be 14,500 feet, rather than 14,000 feet, to take equipment tolerances into account.

In light of the comments received and after further review, the FAA believes that there is insufficient evidence at the present time to justify a requirement for the automatic presentation of oxygen dispensing units before the cabin pressure altitude exceeds 14,000 feet, and that the widely-used value of 15,000 feet provides an adequate level of safety. Proposed § 25.1447(c)(1) is revised accordingly.

Several commentators disagreed with the provision in proposed § 25.1447(c)(1) that would require that each occupant be provided with a manual means to make the oxygen dispensing unit immediately available, contending that manual back-up for the automatic presentation system should be provided for use by the crew only, to avoid tampering by the passengers. Another commentator stated that the average passenger would not be capable of operating such manual means properly and quickly, and that manual means are not feasible for ceiling or hatrack mounted dispensing units.

The FAA believes that a manual means must be provided to back up the automatic presentation system, but is persuaded that it may not be in the interest of safety to require that a manual means be provided for passengers. Accordingly, proposed § 25.1447(c)(1) is revised to require only that a manual means for the development of the dispensing units be provided for the crew.

No unfavorable comment was received concerning proposed § 25.1447(c)(2) and it is adopted as proposed.

Proposal 5-35. Several commentators recommended that proposed § 25.1450 be revised to require a means to indicate that the generator (or replacement element) has not been used and is capable of providing its rated amount of oxygen. The FAA believes that, in view of current § 25.1441(c), there is no need for this additional requirement.

Several commentators objected to proposed § 25.1450(b)(2)(i) on the ground that a positive flow indicating device located on the generator would provide insufficient safety improvement for the cost involved. After further review, the FAA does not believe that there exists adequate justification for the proposed requirement at the present time and it is withdrawn.

One commentator suggested that the word "installation" be added after the word "generator" in the lead-in of proposed § 25.1450(b) because, as proposed, the surface temperature of the actual generator must be contained by its installation. The FAA sees no need for this revision.

One commentator questioned the desirability of replacing generator elements during flight. The FAA believes that the practical problems of manually replacing and stowing expended generator elements, which reach high temperatures, make it very unlikely that generators requiring manual in-flight replacement of elements would be utilized. Instead, generator elements would be replaced during ground maintenance. For this reason, proposed § 25.1450(c)(2) is withdrawn.

One commentator objected to proposed § 25.1450(c)(1)(ii) contending that the proposal should not require that the generator placard contain the duration of the replacement element since a means to determine flow in the dispensing equipment is provided. The FAA does not agree; it is necessary that the duration of the replacement element be on the placard to reduce the probability that an element of insufficient capacity is inserted when the generator is serviced.

Proposal 5-36. Several commentators objected to proposed §§ 25.1457(b) and 29.1457(b). The FAA believes that the comments received raise valid questions as to whether compliance with proposed §§ 25.1457(b) and 29.1457(b) would necessarily improve cockpit voice recorder intelligibility, and whether requiring multiplexing or separate area microphone recording channels (involving extensive redesign of the cockpit voice recorder) could be justified on a cost-benefit basis. Accordingly, proposed §§ 25.1457(b) and 29.1457(b) are withdrawn.

Several commentators objected to proposed §§ 25.1457(d)(1) and 29.1457(d)(1) because the additional load on the emergency bus would reduce the power available to sustain safe flight in an emergency. The FAA agrees, and proposed §§ 25.1457(d)(1) and 29.1457(d)(1) are withdrawn.

Two commentators objected to proposed §§ 25.1457(e) and 29.1457(e) contending that, although the random storage method may have caused problems in earlier years, the cockpit voice recorder manufacturers have since taken steps to eliminate the problem by improvements in design, and there is therefore no justification for specifying that the tape be stored on reels, which is an unnecessarily restrictive requirement. In light of this comment and after further review by the FAA, §§ 25.1457(e) and 29.1457(e) are withdrawn. In view of the withdrawal of proposed §§ 25.1457(b),(d)(1), and (e) and 29.1457(b),(d)(1), and (e) the related provisions of proposed §§ 121.359(c)(3) and (c)(4) and 127.127(b) are also withdrawn.

Several commentators suggested that the underwater locating device specified in proposed §§ 25.1457(g)(3) and 121.359(c)(2)(iii) was superfluous when the flight recorder (which must have an underwater locating device under current § 121.343(f)) and the cockpit voice recorder are co-located. The FAA agrees that an exception is warranted in this circumstance, provided that the installation of the flight recorder and the cockpit voice recorder is such that they are not likely to be separated during crash impact. Accordingly, proposed § 121.359(c)(2)(iii) is adopted with this exception. No revision to proposed § 25.1457(g)(3) is needed and proposed § 25.1457(g) is adopted without substantive change.

Two commentators objected to proposed § 121.359(c)(2) on the ground that up to 3 years would be needed by the airlines to make the airplane modifications prescribed. The FAA agrees, and the lead-in of proposed § 121.359(c)(2) is revised to allow 3 years (from the effective date of this amendment) for compliance. Proposed § 121.359(c) is adopted with the revisions discussed herein.

Proposal 5–37. Several commentators objected to proposed § 25.1459(a)(4), which would require a means for pre-flight checking of the flight recorder for proper operation. One commentator stated it is not technically within the state-of-the-art to meet this test requirement for foil-recording systems, and that the proposed requirement is unnecessarily restrictive. Another commentator contended that there would be a prohibitive increase in flight-crew and ground-crew workload to conduct the proposed test. In light of these comments, and after further review by the FAA, the FAA believes that proposed § 25.1459(a)(4) would be unnecessarily restrictive. Accordingly, proposed § 25.1459(a)(4) is withdrawn.

No unfavorable comments were received concerning proposed § 25.1459(d) and the proposed deletion of current § 25.1459(a)(7). Accordingly, § 25.1459(a)(7) is deleted and proposed § 25.1459(d) is adopted without substantive change. In addition, since the intent of the proposal was that it only apply to airplanes type certificated in the future, § 121.343(e), which requires compliance with the provisions of § 25.1459, is clarified by revising the first sentence of the lead-in to state that the applicable requirements are those of § 25.1459 in effect one day prior to this amendment.

Proposal 5–38. One commentator objected to proposed § 25.1461, contending that there is no need for it since current §§ 25.1309 and 25.901(c) provide adequate coverage for this item. The FAA does not agree. Sections 25.1309 and 25.901(c) list general requirements, the former for all classes of equipment and the latter for powerplant installations. These general requirements do not contain the detailed airworthiness standards specifically applicable to high energy rotors that the FAA believes are necessary for the reasons stated in the explanation of this proposal.

Another commentator suggested that the proposal be clarified as to whether § 25.1461 (a) requires compliance with either paragraph (b), or (c), or (d). The FAA believes that the proposed language is clear in this respect. The applicant is required to comply with one of those paragraphs, and he may select any one of them.

For another comment related to this proposal, see Proposal 5–17.

The proposal to add a new § 25.1461 is adopted without substantive change.

Proposal 5–39. For comments related to proposed § 27.1301 and for the withdrawal of proposed § 27.301, see Proposal 5–1.

Proposal 5–40 For comments related to the proposal to amend § 27.1309(a), and for the withdrawal of this proposal, see Proposal 5–22.

Proposals 5–41 and 2–129. The disposition of the proposals to add new §§ 27.1311 and 27.1329 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7; Airframe Proposals (Notice 75–26; 40 FR 24802; June 10, 1975). See Proposal 5–7.

Proposal 5–42. For comments related to proposed § 27.1321(a), and the withdrawal of proposed § 27.1321(a), see Proposal 5–3.

For comments related to proposed § 27.1321(d), see Proposals 5–3 and 5–23.

Proposal 5–43. For a comment related to the proposal to add a new § 27.1323(a), see Proposal 5–4. No unfavorable comments were received concerning proposed § 27.1323(b). The proposal to amend § 27.1323 is adopted without substantive change.

Proposals 5–44, 2–35, 2–83, 2–128 and 2–183. Several commentators objected to proposed § 27.1325(b) in Proposal 5–44 on the ground that Part 27 rotorcraft are not normally certificated for flight under IFR or icing conditions. Since static vent icing may occur during both VFR and IFR conditions, the FAA believes there is ample justification for requiring an anti-icing means or an alternate source of static pressure for the certification of all rotorcraft employing a static pressure system for required instruments.

One commentator stated that even if a static pressure system failure occurred, it would not jeopardize safe flight and a safe landing. The FAA disagrees. A static pressure failure would result in the loss of reliable airspeed and altitude information.

Another commentator stated that the implication of proposed § 27.1325(b) in Proposal 5–44, when compared with current § 23.1325(b)(3), is that the reading of the altimeter when on the alternate static pressure system cannot differ from the reading of the altimeter when on the primary static pressure system. The FAA agrees and proposed § 27.1325(b) is revised by adding a sentence identical to the last sentence of current § 23.1325(b)(3) which indicates that error is allowed and requires a correction card for errors greater than 50 feet.

Disposition of Proposals 2-35, 2-83, 2-128 and 2-183 to amend §§ 23.1325, 25.1325, 27.1325 and 29.1325, respectively (Notice 75-10) was deferred so that they could be considered in connection with Proposal 5-44.

One commentator stated that proposed § 23.1325(c), which would provide for more complete duality of static pressure sources, should not be applied to unpressurized aircraft if it is demonstrated that the static pressure system calibration, when each static pressure source is selected, is not changed by the other static pressure source being open or blocked.

The FAA believes this suggestion has merit with respect to the proposed requirement that when a static pressure source is selected the other static pressure source must be blocked off. However, the exception would only be appropriate if it is demonstarted that the static pressure system calibration, when each static pressure source is selected, is not changed by the other static pressure source being open or blocked.

Accordingly, proposed §§ 23.1325(c), 25.1325(g), 27.1325(b), and 29.1325(f) (Proposals 2-35, 2-83, 2-128, and 2-183, respectively) are adopted without substantive change (proposed § 27.1325(b) in Proposal 2-128 and proposed § 29.1325(f) in Proposal 2-183 are redesignated §§ 27.1325(c) and 29.1325(g), respectively, in view of the adoption of Proposals 5-44 and 5-57) and new §§ 23.1325(d), 25.1325(h), 27.1325(d), and 29.1325(h) contain the exception discussed here.

Proposal 5-45. For comments related to the proposal to amend § 27.1327, and for an explanation of revisions to current § 27.1327(a) and proposed §§ 27.1327(b) and (c), see Proposal 5-6.

Proposal 5-46. For comments related to the proposal to add a new § 27.1335, and for an explanation of the revisions to proposed § 27.1335, see Proposal 5-27.

Proposal 5-47. For comments related to the proposal to add a new § 27.1351(e), see Proposal 5-9.

Proposal 5-48. For comments related to proposed §§ 27.1353(b)(1) and 27.1353(g), see Proposal 5-10.

Proposal 5-49. No unfavorable comments were received on the proposal to amend § 27.1357(b). Accordingly, the proposal is adopted without substantive change.

Proposal 5-50. The proposed amendment of § 27.1401 relating to anticollision light field of coverage, color, and minimum intensity requirements has been adopted, with revisions, in a separate rule-making action (Amdt. 27-10; 41 FR 5290), as noted previously in this preamble.

Proposal 5-51. The disposition of the proposal to amend § 27.1545 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7; Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-18.

Proposal 5-52. For comments related to the proposal to add a new § 27.1547(e), and for an explanation of the revisions to proposed § 27.1547(e), see Proposal 5-19.

Proposal 5-53. For comments related to proposed § 29.1301 and for the withdrawal of proposed § 29.1301, see Proposal 5-1.

Proposal 5-54. One commentator questioned the exception in proposed § 29.1303(g) in that it only applies to those rotorcraft with a third attitude indicating system and does not apply to those rotorcraft that are only required to have one attitude indicating system but have two. The FAA does not have sufficient information at this time to justify extending the proposed exception, as recommended by the commentator.

Another commentator suggested that the 30-minute minimum interval specified in proposed § 29.13030(g)(3) should be changed to "half the endurance of the rotorcraft". The FAA believes the proposed requirement would give the flight crew sufficient time to take corrective action, or land, as the situation may dictate.

Accordingly, § 29.1303(g) is adopted as proposed.

Proposal 5-55. For comments related to the proposal to amend § 29.1309, see Proposal 5-22.

Proposal 5-56. For comments related to proposed § 29.1321(a) and the withdrawal of proposed § 29.1321(a), see Proposal 5-3.

For comments related to proposed § 29.1321(g), see Proposals 5-8 and 5-23.

Proposal 5-57. For comments related to proposed § 29.1325(c), see Proposal 5-44. In light of the comments received and after further review, the FAA believes that there is not sufficient justification to adopt a requirement for Part 29 rotorcraft that is more restrictive than that in proposed § 27.1325(b) for Part 27 rotorcraft. Accordingly, proposed § 29.1325(c), as adopted, is revised to be substantively identical to § 27.1325(b) as adopted.

Proposals 5-58 and 2-184. The disposition of the proposals to amend § 29.1311 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-7.

Proposal 5-59. For comments related to the proposal to add a new § 29.1335, and for an explanation of the revisions to proposed § 29.1335, see Proposal 5-27.

Proposal 5-60. For comments related to the proposal to add a new § 29.1351(c), see Proposal 5-28. For comments related to the proposal to add a new § 29.1351(d), see Proposal 5-9.

Proposal 5-61. For comments related to proposed §§ 29.1353(c)(1)(i) and 29.1353(c)(6), see Proposal 5-10.

Proposal 5-62. A commentator suggested that it would be more appropriate to cover the content of proposed § 29.1355(b)(1) in § 29.1309 or § 29.1351. The FAA does not agree. Proposed § 29.1355(b)(1) states a requirement concerning distribution systems and distribution systems are the subject matter of current § 29.1355. Accordingly, § 29.1355(b)(1) is adopted without substantive change.

Proposal 5-63. The proposed amendment of § 29.1401 relating to anticollision light field of coverage, color, and minimum intensity requirements has been adopted, with revisions, in a separate rule-making action (Amdt. 29-11; 41 FR 5290, as noted previously in this preamble.

Proposal 5-64. For comments related to the proposal to revise §§ 29.1457(b),(d)(1), and (e), and for the withdrawal of that proposal, see Proposal 5-36.

Proposal 5-65. The disposition of the proposal to amend § 29.1545 has been deferred until final rule-making action is taken with respect to the proposals contained in Airworthiness Review Program, Notice No. 7: Airframe Proposals (Notice 75-26; 40 FR 24802; June 10, 1975). See Proposal 5-18.

Proposal 5-66. For a comment related to the proposed revision of § 91.33(d)(3), see Proposal 5-54.

Section 91.33(d)(3) is adopted as proposed.

Proposal 5-67. One commentator objected to the proposal to amend § 91.36 because he believed it would allow compliance with either current § 91.36(b) or proposed § 91.36(c). The commentator misinterpreted the proposal. The proposal would require compliance with § 91.36(a), (b), and (c).

Another commentator contended that the term "performance standards" in proposed § 91.36(c) would cause confusion and suggested that the word "performance" be deleted. Since the intent of the proposal was to require compliance with all of the minimum standards in the specified TSOs, the FAA agrees with the comment and the word "performance" is deleted in the amendment.

Two commentators suggested revisions to proposed § 91.36(c) that would, in effect, allow the continued operation of currently installed pressure altitude reporting equipment using altimeters and digitizers that do not meet the standards in TSO-C10b and TSO-C88 respectively. The FAA believes that unless these standards are met, there is not assurance that altimeters and digitizers will perform their important probable operating conditions during flight. For this reason, that commentators' suggestion is not adopted. However, after further consideration, the FAA believes that the proposed one-year installation period (after the effective date of the amendment) may not allow enough time to procure and install altimeters and digitizers which comply. Accordingly, the amendment as adopted prescribes a two-year installation period.

One commentator recommended that proposed § 91.36(c) be revised by replacing the term "digitizers" with the term "automatic pressure altitude digitizer equipment" (which is the complete term used in current TSO-C88) because the use of the term "digitizers" would allow approval of equipment that did not meet the standards in TSO-C88. The FAA does not believe that the recommended revision is necessary. It is clear that the equipment referred to must meet the standards in TSO-C88.

The proposal to amend § 91.36 is adopted with the revisions discussed herein.

Proposal 5-68. After further consideration of the proposal to amend § 121.337, and in light of the comments received, the FAA believes that the issues involved warrant further study. Accordingly, the proposal to amend § 121.337 is withdrawn.

Proposal 5-69. Several commentators objected to proposed § 121.343(a). The objections included the following:

- Each new airplane design is sufficiently different to preclude identifying identical components, and system status, that would have the same effect upon controlled flight.
- Flight recorders meeting the current requirements are providing the answers for accident investigation. There is no hard evidence that additional parameters are needed.
- The proposed additional parameters represent a growth of over 100 percent in existing flight recorder systems, with a corresponding growth in system complexity. The result would be a sharp decrease in the reliability of not only the flight recorder but also of the equipment monitored, much of it essential to safe flight.
- The proposed additional parameters would require the installation of systems and components of major cost whose sole purpose is to aid accident investigation. One commentator estimated that the modification program would cost the airline industry $35 million, including airplane out-of-service costs. There would also be greatly increased maintenance costs because of the increased complexity of the system.
- The proposed additional parameters have not been justified on a cost-benefit basis, and no rationale has been given to justify the selection of the proposed parameters from all of the parameters that could be recorded.
- Although some of the proposed additional parameters may enhance the recording system, the implementation of even these would take at least three years.
- The proposal does not provide ranges, accuracies, or recording intervals for the additional parameters.

In the light of these comments, and after further review, the FAA believes that the need for the proposed additional flight recorder parameters has not been justified. Moreover, the FAA now believes that standards setting forth acceptable ranges, accuracies, and recording intervals, for such additional parameters should be developed concurrently with the requirement that they be provided.

Accordingly, proposed § 121.343(a) is withdrawn.

Proposal 5-70. For comments related to the proposal to revise § 121.359(c) and for an explanation of the revisions to proposed § 121.359(c), see Proposal 5-36.

Proposal 5-71. For comments related to the proposal to revise § 127.127(b) and for the withdrawal of that proposal, see Proposal 5-36.

DRAFTING INFORMATION

The principal authors of this document are Irving Fagin, Flight Standards Service, and James M. Barron and Keith S. May, Office of the Chief Counsel.

ADOPTION OF THE AMENDMENTS

Accordingly, Parts 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, 91, and 121) are amended as follows, effective September 1, 1977.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); and the sec. 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE.—The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11821, as amended by Executive Order 11949, and OMB Circular A-107.

Amendment 25-42

Airworthiness Review Program

Amendment No. 6: Flight Amendments

Adopted: January 9, 1978 **Effective: March 1, 1978**

(Published in 43 FR 2302, January 16, 1978)

SUMMARY: The purpose of these amendments to the Federal Aviation Regulations is to update and improve—(1) the airworthiness standards applicable to aircraft performance, flight characteristics, flight manuals, and operating limitations; (2) the operating rules containing related airworthiness standards; and (3) the rules governing holders of type certificates. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

Adolfo O. Astorga, Airworthiness Review Branch (AFS-910), Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591; telephone (202) 755-8714.

SUPPLEMENTARY INFORMATION: These amendments are the sixth in a series of amendments to be issued as part of the Airworthiness Review Program. The following series of amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR citation*
Form number and clarifying revisions.	(40 FR 2576; Jan. 14, 1975).
Rotorcraft anticollision light standards.	(41 FR 5290; Feb. 5, 1976).
Miscellaneous amendments.	(41 FR 55454; Dec. 20, 1976).
Powerplant amendments.	(42 FR 15034; March 17, 1977).
Equipment and systems amendments.	(42 FR 36960; July 18, 1977).

These amendments are based on two Notices of Proposed Rule Making—Notice 75-10 published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802); and Notice 75-25 published in the FEDERAL REGISTER on June 9, 1975 (40 FR 24664). The amendments based on Notice 75-10 were deferred in the series of amendments titled "Miscellaneous Amendments" so that they could be considered with the final disposition of certain proposals in Notice 75-25. The discussions of the comments received for the deferred proposals are included under the heading of the related Notice 75-25 proposals.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those contained in Notices 75-10 and 75-25.

DISCUSSION OF COMMENTS

The following discussion is keyed to the like-numbered proposals contained in Notice 75-25.

Proposal 6-1. No unfavorable comments were received on the proposal to amend § 1.1 by deleting the term "Accelerate-stop distance" and its definition. Accordingly, the proposal is adopted without substantive change.

Proposal 6-2. For a comment related to the proposal to amend § 1.2, see Proposal 6-84.

Proposal 6-3. One commentator suggested that proposed new § 21.5 concerning Airplane and Rotorcraft Flight Manuals be revised to make clear that other titles for the required Flight Manual, such as Pilot's Operating Handbook, will continue to be approved. The FAA has no objection to the use of the term Pilot's Operating Handbook as the main title. However, if an applicant chooses to use the title Pilot's Operating Handbook, he must include a statement on the title page indicating that the document is the FAA-required Airplane or Rotorcraft Flight Manual.

The same commentator pointed out that on airplanes of types for which Flight Manuals were not furnished in the past, much of the required information was furnished on placards and markings, and that, if this proposal is adopted, some of the placards would no longer be needed but would still be part of the airplane's certification basis. The FAA agrees that some placards may not be necessary after the information is furnished in a Flight Manual. However, application may be made to change the type design if the applicable regulations only require that the material be in either a Flight Manual or in any combination of approved manual materials, markings, and placards.

The same commentator also stated that proposed § 21.5(b) would penalize airplanes that were designed and tested to temperatures higher than the hot day condition prescribed in § 23.1043(b)(1). The FAA does not agree because the temperature for which cooling was demonstrated would be furnished in the Flight Manual as information, not as a limitation. It should be noted that, in response to Proposal 6-29, this commentator stated that there is no objection to furnishing the test temperature if it is not a limitation.

Two commentators stated that it should be made clear that, for rotorcraft originally certificated with a flight manual, the manual originally approved need not be revised to include the new requirements of this proposal. The FAA does not believe a revision is necessary since proposed § 21.5(b), in conjunction with proposed § 21.5(a), refers only to airplanes or rotorcraft that were not type certificated with an Airplane or Rotorcraft Flight Manual.

Another commentator said that requiring Flight Manuals to be furnished for aircraft previously type certificated without a Flight Manual places too large a burden on the holders of these type certificates. The FAA does not agree since the information to be included in the Flight Manual has already been furnished in other forms. In addition, a Flight Manual would provide the operator with essential information in a consolidated, organized form suitable for study and reference. The FAA believes that these benefits outweigh the burden of preparing and printing the Manual.

One commentator, who concurred with the proposal, recommended that the turbulent air penetration speed, least angle of glide speed, and least rate of descent speed (power off) be added to the required information. These are specific requirements which are not applicable to all categories of aircraft and the FAA does not believe they should be included in the rule.

The phrase "maximum anticipated air temperature" in proposed § 21.5(b)(2) is deleted and the phrase "maximum ambient atmospheric temperature" is inserted in its place to be consistent with Proposal 6-20 to amend § 23.1043 and the corresponding proposals for the other certification parts, which are being adopted in this series of amendments.

The proposal to add a new § 21.5 is adopted with the revision discussed above.

Proposal 6-4. For comments related to the proposal to amend § 23.25(b), see Proposal 6-5. The proposal to amend § 23.25(b) is adopted without substantive change.

Proposal 6-5. One commentator objected to the proposal to amend § 23.29, which would require the empty weight to be determined with "full" operating fluids, on the ground that this procedure would eliminate the option of "off loading" oil in order to maintain weight and center of gravity limits. The FAA does not agree. This option would not be eliminated by proposed § 23.29 since it merely establishes a new reference basis for empty weight. The same commentator stated that since this proposed rule is not retroactive, confusion will result because some aircraft will have oil included in the weight and balance and others will not. This commentator also suggested that the use of the same definition of empty weight by the FAA and the military would eliminate the difficulties encountered by pilots operating both military and civil aircraft. The FAA does not believe that the proposed change will cause confusion or difficulty in either situation cited by the commentator since the weight and balance data accompanying each airplane will specify whether oil is included in the empty weight. Further, this procedure should simplify weight and balance computations since fluids normally included will be accounted for without further additions to the empty weight.

One commentator objected to the proposals to amend §§ 27.29 and 29.29 on the ground that there is no benefit to be gained by changing the definition of empty weight. The FAA does not agree with this comment for the reasons stated in the Notice for these proposals. This commentator further objected to the proposal to amend § 27.29 on the ground that it would create a problem for helicopters that have a larger oil tank capacity than is required under all conditions, such as helicopters designed to accept auxiliary fuel tanks. The option of off-loading oil would not be eliminated by proposed § 27.29. In addition, the FAA believes that the change will accomplish its purpose of simplifying weight and balance computations for the great majority of helicopters.

Several commentators on the proposal to amend § 25.29 noted that the proposed rule would require certain fluids which, in transport category airplanes, are variable as a function of individual operator or mission requirements and of passenger seating density (such as potable water and lavatory pre-charge fluids) to be included in the empty weight. It was suggested that an exception be provided for those fluids that vary with operation or mission as well as those that are expendable in flight such as water intended for injection in the engines. The FAA believes that exceptions for the specific fluids noted are warranted for airplanes, but the FAA does not believe that an exception is appropriate for potable water or lavatory pre-charge water for rotorcraft. The proposals to amend §§ 23.29 and 25.29 are revised accordingly.

Proposal 6–6. A commentator objected to the proposed change to § 23.45, stating that a requirement to correct the performance to 80 percent relative humidity is not necessary, that it would increase the cost and complexity of certification without any increase in safety, and that it will create a new standard atmosphere that will result in confusion as to the basis for engine performance data. The power loss that is associated with changing from dry air to air at 80 percent relative humidity would cause a significant reduction in the climb performance of a reciprocating-engine powered airplane and should be considered. This reduction would be most evident where performance is marginal, e.g., during one-engine-inoperative climb. With regard to turbine engines, the FAA believes that the effect of humidity may be negligible on some types of engines, in which case no performance correction would be necessary. However, for some other types of turbine engines, a correction for humidity will increase the accuracy of the performance data. The FAA believes that the data required for making the corrections can be obtained simply and with inexpensive instrumentation. Further, the FAA does not believe that requiring a correction for humidity in the performance data for newly type-certificated airplanes will result in confusion. A transition period may exist during which the performance data for newly type-certificated airplanes will be corrected for humidity and that for other airplanes may not be. Such transition periods inevitably occur with the adoption of new regulatory provisions and the FAA does not believe that the transition in this case will present a significant problem.

The commentator further stated that present performance measurement accuracy is within the range of uncontrolled airplane-to-airplane variations, atmospheric variations other than humidity, and piloting variations, and that eliminating one variable whose effect is within the spread of other variables is not justifiable on a simple cost-benefit analysis. The FAA does not agree that the humidity correction should be omitted on the basis of conjecture that other variables may mask its effect. Certification flight testing is not allowed when atmospheric variables would affect data accuracy, and tests must be repeated as necessary to establish confidence in data accuracy.

In regard to the burden of correcting for humidity in type certification, the FAA believes that it should in many cases be possible to show that the effect of humidity is not significant or that it is covered by a conservative correction factor. Correction of performance data to standard atmospheric conditions of temperature and pressure is required in any case, and an additional correction for humidity should be a relatively small burden.

The proposal for § 23.45 is adopted without substantive change.

Proposal 6–7. No unfavorable comments were received on the proposal to amend § 23.49. Accordingly, the proposal is adopted without substantive change.

Proposal 6–8. One commentator suggested that, for consistency with certain foreign requirements, proposed §§ 23.51(c)(1)(ii) and (c)(2)(i) should be revised to read 1.2 V_{S_1}, instead of 1.3 V_{S_1}. The FAA does not believe that the recommended change is necessary. Proposed §§ 23.51(c)(1)(ii) and (c)(2)(i) already provide for a speed less than 1.3 V_{S_1}.

The first commentator also stated that proposed § 23.51(c)(1)(ii) should be revised so that it refers to the complete failure of a single engine (on multi-engine airplanes) instead of complete engine failure which would introduce a double failure concept not inherent in these rules. The FAA does not agree. Proposed § 23.51(c)(1)(ii), which is consistent with current § 23.51(a)(2)(ii) in this regard, only requires that "complete engine failure" be investigated if a speed of less than 1.3 V_{S_1} is demonstrated at a height of 50 feet. In addition, current § 23.51(a)(2)(ii) has been consistently interpreted to require that for multi-engine airplanes which meet the powerplant isolation requirements of § 23.903(c) in the takeoff configuration, only one engine need be made inoperative in the specified investigations.

One commentator objected to the extension of takeoff performance determination requirements to airplanes of 6,000 pounds and less maximum weight, for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Another commentator recommended that those provisions of the existing rule which relate to nosewheel and tailwheel liftoff speeds be retained and that their applicability be extended to all airplanes. These provisions were originally imposed in lieu of a requirement for approved takeoff performance data for airplanes of 6,000 pounds and less maximum weight. In view of the requirements which are being adopted, and in view of satisfactory service history for airplanes of more than 6,000 pounds maximum weight, the FAA does not believe these provisions should be retained or that their applicability should be extended to all airplanes.

The proposal to revise § 23.51 is adopted without substantive change.

Proposal 6-9. One commentator objected to the application of proposed § 23.65, concerning all-engines operating climb requirements, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Another commentator stated that use of a reduced propeller pitch under proposed § 23.65(b) is not consistent with safety requirements, because it would either deny the pilot performance in actual operation or the protection of limiting the engine to a safe speed. The FAA does not agree. Present § 23.33 defines the pitch and speed limitations for propellers which are to be used in service. Proposed § 23.65(b), which is identical to the present § 23.65(a)(2), merely authorizes the use of a special test propeller pitch setting if it is necessary to obtain rated engine r.p.m. at V_x.

In proposed § 23.65(c), reference to the airplane configuration was inadvertently omitted. The configuration should be the same as that specified in proposed § 23.65(a), and proposed § 23.65(c) is therefore revised to state that the climb gradient is to be met with the airplane in the configuration prescribed in paragraph (a). In addition, § 23.65(a)(4) is revised to cover means other than cowl flaps for controlling the engine cooling air supply. This change is necessary to provide for turbine engines. The proposal to revise § 23.65 is adopted with the revisions discussed above.

Proposal 6-10. One commentator suggested that a speed to be used in calculating the climb gradients should be specified in proposed § 23.67(c) for purposes of uniformity, but did not make a specific proposal. The FAA believes that the applicant should be allowed to select a climb speed if the airplane meets the minimum gradient and rate of climb at that speed. The proposal to amend § 23.67 is adopted without substantive change.

Proposal 6-11. One commentator objected to the application of proposed § 23.75, concerning landing distance requirements, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3. This commentator also stated that proposed § 23.75(e), concerning wheel brake pressures, is a design requirement and should therefore be placed in Subpart D of Part 23. The FAA does not agree because proposed § 23.75(e) refers to the pressures used in determining the landing performance. The commentator further suggested that the FAA should consider issuing advisory material as to what is considered safe and reliable under proposed § 23.75(f). The wording of proposed § 23.75(f) is the same as that of present § 25.75(b)(3), and this wording has been administered without difficulty for many years. However, the FAA will consider issuing advisory material at a future date if the need is shown.

Another commentator stated that he would not support the inclusion of reverse thrust as an acceptable "other means" of retarding the airplane in determining the landing distance under proposed § 23.75(f), because the landing distance is demonstrated on a dry runway with no provision for a field length factor. The FAA agrees that the effect of wet runways would have to be taken into account in any determination that a means of retarding the airplane is safe and reliable and that consistent results can be expected in service use. It should be noted that proposed § 23.1587(a((6) (Proposal 6-31), as adopted, requires that the kind of surface used in the landing distance tests be described in the Airplane Flight Manual. The proposal to revise § 23.75 is adopted without substantive change.

Proposal 6-12. One commentator objected to the application of proposed § 23.77, concerning balked landing performance, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3. Proposed § 23.77 is adopted without substantive change.

Proposals 6-13 and 2-6. One commentator stated that the option in proposed (and current) § 23.149(a) for the applicant to choose zero yaw or an angle of bank is inconsistent because straight flight with zero yaw (zero sideslip) can only be achieved with some degree of bank. The FAA agrees that bank may be needed to establish straight flight with zero yaw following the failure of a powerplant at low airspeed. The proposed language is the same as that of the current rule and an angle of bank of up to 5 degrees to maintain straight flight has been allowed under the current rule. The directional controllability that must be provided for compliance with §§ 23.147 and 23.205 ensures that bank angles up to 5 degrees under these flight conditions will not be accompanied by excessive yaw angles. Certain design or control features may influence the use of roll control immediately following the failure of a powerplant. Therefore, the proposal (as well as the current rule) allows reference to a zero yaw angle, without bank, for determining the V_{MC} of airplanes which incorporate such features.

Section 23.149(a) is revised in accordance with the discussion of Proposal 6-41 with respect to the modes of failure which must be simulated in demonstrating V_{MC}. The revision requires that the method used to simulate critical engine failure must represent the most critical mode of powerplant failure with respect to controllability that is expected in service, rather than (all) modes of powerplant failure expected in service.

Proposal 2-6 to amend § 23.149(b) (Notice 75-10) was reproposed in Proposal 6-13 for the purpose of clarity. No unfavorable comments were received on proposed §§ 23.149 (b),(c), and (d), and they are adopted without substantive change.

Proposal 6-14. One commentator objected to the application of proposed § 23.161 to airplanes of 6,000 pounds and less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Since § 23.21(a) requires that each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested, proposed § 23.161(a)(2)(ii) is revised by deleting the reference to center of gravity and proposed § 23.161(c)(2)(iii) is withdrawn.

Proposal 6-15. No unfavorable comments were received on the proposal to amend § 23.177. Accordingly, the proposal is adopted without substantive change. For comments related to the proposal to amend § 23.177, see Proposal 6-16.

Proposal 6-16. One commentator objected to proposed § 23.181(b), which would require that short period lateral or directional oscillations and combined lateral-directional oscillations ("Dutch roll") be damped to 1/10 amplitude in 7 cycles. The commentator stated that this proposal is more stringent with regard to combined lateral-directional oscillations than proposed § 25.181 (Proposal 6-43) and that proposed § 25.181 retains certain necessary requirements for other short period oscillations that are not contained in proposed § 23.181. Proposed § 25.181(a) would require that oscillations other than combined lateral-directional oscillations be heavily damped, and proposed

§ 25.181(b) would require combined lateral-directional oscillations to be positively (but not heavily) damped. The FAA agrees that a similar distinction should be made in § 23.181 between combined lateral-directional ("Dutch roll") oscillations and other longitudinal, lateral, and directional oscillations.

Current §§ 23.177(a)(4) and (b)(3) (which are deleted by Proposal 6-15) require any short period lateral or directional oscillation to be heavily damped. After considering the comment and after further review, the FAA believes that the current requirement for heavy damping should be retained for short period lateral and directional oscillations other than "Dutch roll" (combined lateral-directional) oscillations. With respect to combined lateral-directional oscillations, the FAA believes that these oscillations do not need to be heavily damped and that the proposed requirements for Part 23 airplanes would provide a satisfactory damping ratio.

The FAA believes the difference between Part 23 and Part 25 requirements with respect to combined lateral-directional oscillations is justified since airplanes certificated under Part 25 have very large variations in size, weight, and moment of inertia, which affect the lateral-directional characteristics and pilot reaction to these characteristics. The FAA therefore believes that it is appropriate that the damping requirement in § 25.181(b) be stated in general terms, as reflected in Proposal 6-43.

The proposal to amend § 23.181 is adopted with the revisions discussed above.

Proposal 6-17. Proposed new § 23.183 would establish a limit on the rate of spiral divergence by requiring that the angle of bank may not increase to more than 40 degrees in less than 12 seconds after the controls are released in a 20-degree banked turn under specified conditions. One commentator objected to the proposal stating that no need had been shown for the proposal and that the tests referred to in the notice were not definitive. After comparing available data on the subject of spiral divergence, the FAA believes that rulemaking on this subject is premature. Accordingly, the proposal to add a new § 23.183 is withdrawn.

Proposal 6-18. Many comments were received on the proposal to amend § 23.221. In view of the conflicting views expressed in these comments, and after further consideration by the FAA, the FAA believes that the proposal to amend § 23.221 is premature, and it is withdrawn.

Proposal 6-19. One commentator stated that the proposal to amend § 23.729(f)(1) is redundant and that the requirement proposed is already in effect. The FAA does not agree with the comment for the reasons stated in the notice.

The proposal to amend § 23.729(f)(1) is adopted as proposed except that the last three words, "the aural warning", of the proposed sentence are replaced with the words "the warning device" so that the wording of the sentence is consistent with the remainder of § 23.729(f).

For other comments related to the proposal to amend § 23.729, see Proposal 6-51.

Proposal 6-20. For comments related to the proposal to revise § 23.1043(b), see Proposal 6-23.

Proposal 6-21. One commentator objected to the proposal to amend § 23.1047 for reasons stated in his comments on Proposal 6-3, concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3. The proposal to amend § 23.1047 is adopted without substantive change.

[For discussion concerning new § 23.1353(g), see Proposals 6-57 and 2-87.]

Proposal 6-22. No unfavorable comments were received on the proposal to revise § 23.1501. Accordingly, the proposal is adopted without substantive change.

Proposal 6-23. The proposal to revise § 23.1521(e) is one proposal in a series of proposals on powerplant cooling requirements and ambient temperature operating limitations and information for Parts 23, 25, 27, and 29 aircraft. This series consists of proposals 6-20, 6-23, 6-29, 6-52, 6-54, 6-56, 6-68, 6-71, 6-74, 6-82, 6-85, and 6-88.

Proposed § 23.1521(e) in conjunction with proposed § 23.1043(b) (Proposal 6-20) would require that an ambient temperature operating limitation be established as the maximum atmospheric temperature at which compliance with the powerplant cooling requirements is shown. In response to these proposals, one commentator stated that no justification for safety or other reasons has been presented for establishing the proposed operating limitations, and that he believes that no safety justification exists. The commentator also stated that the FAA cooling tests and correction factors are very conservative, that it would be necessary to correct cooling tests to at least the equivalent of 125 degrees F at sea level to avoid restrictive operating limitations, and that this would result in increased cooling drag and poorer performance. Another commentator, in regard to proposed § 27.1521(f) (Proposal 6–71), also stated that an ambient temperature limitation has not been shown to be necessary.

After considering these comments, and after further review, the FAA believes that it does not now have enough information to justify the proposed requirements for reciprocating engines in Part 23 airplanes and Part 27 rotorcraft. However, because of the differences between reciprocating and turbine engine installations, particularly in regard to engine components and accessories, and because of the effects of high temperature operation on turbines, Part 23 already requires the establishment of ambient temperature limitations for turbine engines, and for the same reasons the FAA believes that ambient temperature limitations for turbine engines should also be established for Part 27 helicopters. Parts 25 and 29 already require temperature limitations for reciprocating engines (as well as turbine engines) because the reciprocating engines in these aircraft are generally more complex than those used in Part 23 and Part 27 aircraft.

Accordingly, proposed §§ 23.1521(e) and 27.1521(f) are revised to require the establishment of ambient atmospheric temperature limitations for turbine but not for reciprocating engines and proposed §§ 25.1521(e) and 29.1521(e) are adopted without substantive change. In addition, proposed §§ 23.1043(b), 25.1043(b), 27.1043(b), and 29.1043(b), as adopted, are revised to omit the reference to a limitation on the operation of the aircraft, since the establishment of ambient temperature operating limitations is prescribed in proposed §§ 23.1521(e), 25.1521(e), 27.1521(f), and 29.1521(e). For reciprocating engines, §§ 23.1587 and 27.1587 are revised to require that the maximum ambient air temperature for which compliance with the eengine cooling requirements was shown must be included in the performance information section of the Flight Manual.

One commentator recommended that the 100-degrees F minimum in proposed § 25.1043 (b) be deleted, since the ambient temperature at which compliance with the cooling requirements is shown becomes an operating limitation on the airplane and airworthiness is not affected as long as the limitation is followed. The FAA believes that the 100-degree F minimum is appropriate since a lower temperature would be impractical and unrealistic considering summer operations in the United States. It should be noted that an exception to the minimum is provided for winterization installations.

This commentator also stated that the explanation for proposed § 25.1043(b) implies that only a test demonstration at 100 degrees F or higher is acceptable. This is incorrect. Section 23.1043(a)(1) and corresponding provisions in Parts 25, 27, and 29 clearly indicate that tests may be conducted under other conditions and corrected to the prescribed conditions.

One commentator recommended the deletion of the requirements in proposed §§ 27.1583(b) and 29.1583(b) for an explanation of the powerplant limitations in the Airplane Flight Manual, since such explanations would be redundant. A similar comment was received in response to proposed § 25.1583(b). The intent of the proposals was not to require an explanation of each limitation. A separate explanation would not be necessary for a limitation that is self-explanatory. For clarification, proposed §§ 23.1583(b)(2), 25.1583(b)(2), 27.1583(b)(2), and 29.1583(b)(2) are revised to require an explanation of limitations "when appropriate."

In regard to proposed § 23.1583(b), one commentator stated that contrary to the FAA statement in the notice, the establishment of the test temperature as a limitation has not been required in the past and should not be a limitation. The FAA disagrees. Current § 23.1583(j) requires that, for turbine engines, the temperatures used in the climb test prescribed in § 23.1043(b)(2), be furnished as operating limitations in the Airplane Flight Manual. Proposed § 23.1583(b) merely makes it clear that any operating limitations that are established under § 23.1521 must be furnished in the Airplane Flight Manual. In view of the adoption of proposed § 23.1583(b) as revised, § 23.1583(j) is deleted and marked "Reserved."

With regard to the proposal to amend § 25.1583 (Proposal 6–56), one commentator recommended the deletion of proposed paragraph (b)(3) concerning powerplant limitations, and paragraph (l) concerning maneuvering load factors. The commentator stated that if the engine instrument markings have to be changed, it should be handled by a service bulletin. The FAA does not agree. The relation between the powerplant limitations and the instrument markings should be explained in the Manual. The commentator also stated that the load factor (number) is meaningless to the pilot as he cannot determine what it is during a pull-up maneuver. He stated that correlation with bank angle is acceptable, but that transport aircraft do not exceed 60 degree bank angles. The FAA believes that the maneuvering load factor should be retained in the Flight Manual because it is established as an operating limitation under § 25.1531, and the correlation with bank angle provides useful information to the pilot concerning the strength limitations of the airplane.

The proposals to amend §§ 23.1583, 25.1583, 27.1583 and 29.1583 are adopted with the revision discussed above.

For consistency in the terminology used in the cooling tests requirements, a nonsubstantive change is being made to §§ 23.1043(a)(1), 23.1043(d), 27.1043(a)(1), 27.1043(d), 29.1043(a)(1), and 29.1043(d) by deleting the words "maximum anticipated air temperature" and inserting in their place the words "maximum ambient atmospheric temperature".

Proposal 6-24. One commentator objected to proposed § 23.1523, which concerns the establishment of the minimum flight crew, stating that it is not necessary to make all aircraft conform to the requirements of Part 25. The FAA believes that proposed § 23.1523 specifies the appropriate requirement that should be considered in determining the minimum flight crew for Part 23 airplanes.

Another commentator said that specification of minimum crew is an operational item that may vary with the type of operation, e.g., for compensation or hire which by law must be conducted in accordance with the highest standards. He concluded that rules specifying the number of crew members for specific operations should be in the operating regulations. The FAA agrees that certain rules concerning the number of crew members properly belong in the operating rules, and this is done, for example, in Subpart M of Part 121. However, under current § 23.1523, the minimum crew is established for VFR only, without requiring consideration of the additional crew duties that arise when IFR operations are authorized. These duties may be imposed by the design and operating characteristics of the aircraft and by its installed equipment. The FAA believes that they must therefore be evaluated during the type-certification process. The proposal to revise § 23.1523 is adopted without substantive change.

Proposal 6-25. One commentator objected to proposed § 23.1541 concerning placards in airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3. Proposed § 23.1541 is adopted without substantive change.

Proposal 6-26. One commentator objected to proposed § 23.1559 concerning placards in airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of those comments, see Proposal 6-3. Proposed § 23.1559 is adopted without substantive change.

Proposal 6-27. Proposed § 23.1567(b)(2) would require that utility category airplanes that do not meet the spin requirements for acrobatic category airplanes have a placard in clear view of the pilot stating "Spins prohibited." One commentator said that the proposal is redundant and would add to the already confusing proliferation of cockpit placards. The FAA does not agree since the proposal would prevent any possible confusion as to whether a particular utility category airplane has been approved for spins. The proposal is adopted without substantive change.

Proposals 6-28, 2-39, 2-43, and 2-45. Proposed § 23.1581(a) is revised in accordance with the discussion of the proposal to amend § 25.1581 (Proposal 6-55). For another comment related to Proposal 6-28, see Proposal 6-3.

Disposition of Proposal 2-39 to add a new § 23.1353(f) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-28. For comments related to proposed § 23.1353(f) and for an explanation of the revision to proposed § 23.1353(f), see the discussion of Proposal 2-87 under Proposal 6-57. Disposition of Proposal 2-45 to revise § 23.1581(b) and to add a new § 23.1581(d) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-28.

One commentator, who agreed in general with proposed § 23.1581(b), recommended several clarifications. He indicated that the title "Pilot's Operating Handbook" should be allowed as an alternative to "Airplane Flight Manual." The FAA has no objection to the title "Pilot's Operating Handbook" if the title page also includes a statement indicating that the document is an FAA-required Airplane or Rotorcraft Flight Manual.

The commentator also indicated that the FAA should delete any requirement for individual page approval for operating limitations in Handbooks that meet a specification acceptable to the Administrator. Proposed § 23.1581(b)(1) would require approval of each page containing the prescribed operating limitations whereas current § 23.1581(b) requires that each part of the Airplane Flight Manual containing information presented in §§ 23.1583 through 23.1589 be approved.

The intent of proposed §§ 23.1581(b)(1) and (b)(2) was to require that the presentation of operating limitations be approved by the FAA and be clearly identified as such while at the same time providing an option for the presentation of the other required information. This option would have provided that each page containing the information prescribed in §§ 23.1585 through 23.1589 had to be determined in accordance with the applicable requirements of this part and had to be approved or the information presented in its entirety in a manner acceptable to the Administrator.

In light of the comments received and after further review, the FAA believes that this intent will be accomplished in a simpler manner, and will be more consistent with Parts 25, 27, and 29 flight manual requirements, by retaining the current requirements and providing an alternative to the current requirements in a separate paragraph which provides that each part containing operating limitations must be approved and limited to such information, and the information prescribed in §§ 23.1585 through 23.1589 must be determined in accordance with the applicable requirements of this part and presented in a manner acceptable to the Administrator. Proposed §§ 23.1581(b)(1) and (b)(2) are revised to reflect the changes discussed above.

The references in proposed §§ 23.1581(b)(1) and (b)(2) to the information prescribed in §§ 23.1581(c) (paragraph (a)(2) as adopted) have been deleted to be consistent with the flight manual requirements of Parts 25, 27, and 29.

One commentator objected to Proposal 2-45 on the grounds that procedures, performance data, and loading information for any airplane certificated under Part 23 would not have to be approved by the FAA. This comment evidently refers to proposed § 23.1581(b)(2)(i) (which is incorporated into paragraph (b)(2) as adopted), under which the information prescribed in §§ 23.1585 through 23.1589 would not be identified as FAA-approved, if this information in its entirety is presented in a manner acceptable to the Administrator. The FAA does not agree with the comment. Under the proposal, the information would have to be determined in accordance with the applicable requirements of Part 23. In finding that a manual is acceptable, the FAA would review the manual to determine that the required information is complete and accurate. The manual would also be reviewed to ensure that any additional information provided by the applicant is not in conflict with required information or contrary to the applicable airworthiness requirements. The FAA believes that § 23.1581(b)(2) will provide an adequate method of review of the information prescribed in §§ 23.1585 through 23.1589.

The proposals to amend § 23.1581 are adopted with the revisions discussed above.

Disposition of Proposal 2-43 to amend § 23.1555 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-28. No unfavorable comments were received on Proposal 2-43, however, proposed § 23.1555(c)(3) is revised by deleting the words "and in the Airplane Flight Manual" in view of the requirements of §§ 23.1581 and 23.1587(a)(2), as adopted.

Proposal 6-29. For comments related to the proposal to revise § 23.1583(b), see Proposal 6-23.

Proposal 6-30. One commentator objected to the application of proposed § 23.1585, concerning operating procedures, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

The proposal to amend § 23.1585 is adopted without substantive change.

[For discussion concerning new § 23.1585(e), see Proposals 6-57 and 2-87.]

Proposals 6-31 and 2-46. One commentator objected to the application of proposed § 23.1587, concerning performance information, to airplanes of 6,000 pounds or less maximum weight for reasons stated in his comments on Proposal 6-3 concerning Flight Manuals. For a discussion of these comments, see Proposal 6-3.

Another commentator stated, in response to proposed § 23.1587(a)(7), which would require information on the steady rate or gradient of climb, that if gradient data are presented, conversion charts should be included, and that ideally each determination should be available; however, he concluded that the option of one or the other should be deleted and a definite requirement adopted. The commentator misinterpreted the proposed requirement. Section 23.65(c), as adopted by this amendment, requires the determination of a gradient of climb for turbine engine powered airplanes. Proposed § 23.1587(a)(7) is worded so as to take into account the requirement of § 23.65(c), not to provide an option for the applicant, i.e., whether gradient of climb or rate of climb is furnished under § 23.1587(a)(7) will be determined by the applicable requirement of §§ 23.65 and 23.77.

Section 23.1587 is adopted as proposed, except that a new § 23.1587(a)(9) has been added to include information on the maximum ambient temperature at which compliance with the cooling requirements is shown for reciprocating engines. This addition is explained in the discussion of the comments on Proposal 6-23.

Disposition of Proposal 2-46 (Notice 75-10), which proposed to delete the second sentence of present § 23.1587(a)(2), was deferred so it could be considered with Proposal 6-31. No unfavorable comments were received on Proposal 2-46. Proposal 2-46 was reproposed in Proposal 6-31, and is adopted without substantive change with the adoption of Proposal 6-31.

Proposal 6-32. Proposed new § 25.21(f) would require that when surface winds must be considered, the wind velocity must be measured at or corrected to a height of 10 meters above the surface, because the National Weather Service is standardizing on a height of 10 meters for reporting winds at airports. One commentator said that since the purpose of the proposal is standardization of Airplane Flight Manual performance information with respect to reported winds for takeoff or landing in service operations, the requirement should be placed in the flight manual requirements under § 25.1587(c)(1)(i) instead of in § 25.21. The FAA agrees that this is one purpose of the proposal but there are flight requirements other than those concerning performance information that require consideration of surface winds. Therefore, the FAA believes that it is more appropriate to include the proposed requirement in § 25.21. However, proposed § 25.21(f) is revised to clarify its applicability.

The proposed change to § 25.21(d), which deals with tolerances for variables in flight testing, would delete the requirement that the tolerance on wind during takeoff and landing tests must be based on the wind measured at a height of 6 feet above the runway. The commentator said that performance analysis is usually based on winds at the height of the mean aerodynamic center of the airplane above the runway surface, and that the data in the Airplane Flight Manual is then corrected to the currently used height of 50 feet. The commentator recommended that this procedure be continued, except that the wind velocities in the Flight Manual should be based on a height of 10 meters instead of 50 feet. The FAA believes that the proposed deletion of the 6-foot height from § 25.21(d), together with proposed § 25.21(f), as revised, would allow continued use of the procedure recommended by the applicant.

The commentator also suggested that the correction chart in Civil Aeronautics Manual 4b Appendix A, Figure 2, be considered for inclusion in Part 25. The FAA does not believe that it is necessary to include this information in the rules.

The proposal to amend § 25.21 is adopted with the revisions discussed above.

Proposal 6-33. For comments related to the proposal to amend § 25.29, see Proposal 6-5.

Proposal 6-34. Several commentators objected to the method of computing V_1 (takeoff decision speed) in proposed § 25.107(a) on the grounds that—(1) the speed increment between V_{EF} (engine failure speed) and V_1 should not be determined with all engines operating because the accelerate-stop distance determined under proposed § 25.109(a) would then be unnecessarily large for the critical engine failure condition (especially for twin-engine airplanes); and (2) placing the 2.0-second time delay between V_{EF} and V_1 in proposed § 25.107(a)(2)(ii) does not adequately provide for these instances in which the pilot may have to analyze and react to an event that occurs immediately before reaching V_1.

It was recommended that proposed § 25.107(a) be revised so that V_1 is determined by adding to V_{EF} the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed and the instant at which the test pilot recognizes and reacts to the engine failure, as indicated by the pilot's application of the first retarding means during accelerate-stop tests (the 2.0-second minimum time delay that was proposed to be included between V_{EF} and V_1 would be deleted). It was further recommended that proposed § 25.109(a) be revised so that a 2.0-second time delay following V_1 is incorporated into the determination of accelerate-stop distances, as follows: (1) for the engine failure case, the acceleration of the airplane from V_{EF} would be with the critical engine inoperative and would continue for 2.0 seconds after reaching V_1; and (2) for the other event case, the acceleration of the airplans would be with all engines operating and would continue for 2.0 seconds after reaching V_1.

After considering all of the comments on these proposals and after further review, the FAA agrees with these comments and the recommendations. The FAA believes that the recommended revisions would provide for events other than engine failure, even though the speed increment between V_{EF} and V_1 would be determined with the critical engine inoperative instead of all engines operating, because the accelerate-stop distance for the other event case would be determined with all engines operating from the start of takeoff until 2.0 seconds after V_1 is reached. Further, the FAA believes that deleting the 2.0 second minimum time delay from the determination of V_1 and inserting a 2.0-second delay after V_1 in the determination of the accelerate-stop distance would be more appropriate for most rejected takeoff situations, since stopping requires a positive decision and action by the pilot. Proposed §§ 25.107(a) and 25.109(a) are revised accordingly.

Several commentators objected to the 2.0-second (minimum) time delay used in computing V_1 under proposed § 25.107(a)(2)(ii) on the grounds that it would increase the required take-off runway lengths, particularly in the engine failure case, and that such increases are not justified. One commentator recommended that the time delay be reduced to 1.0 second. The revisions discussed above significantly reduce the effect of the 2.0-second time delay on the required accelerate-stop distance in the engine failure case. Under § 25.107(a) as proposed, the airplane would be accelerated to a V_1 speed equal to V_{EF} (engine failure speed) plus the speed gained with all engines operating during a total time interval of about 3 seconds (i.e., during the time required for the test pilot to recognize and react to an engine failure in accelerate-stop tests, plus a 2.0-second time delay for service operations). Under proposed § 25.109(a), the accelerate-stop distance for the engine failure case would be determined by accelerating the airplane from V_{EF} to the V_1 speed determined under proposed § 25.107(a), but with the critical engine inoperative instead of with all engines operating. As pointed out by one of the commentators, the total time interval between engine failure and application of the first retarding means could then become about 6 seconds for a twin-engine airplane in the engine failure case, and the distance traversed during the additional 3 seconds (beyond the time interval prescribed in § 25.107(a) would be included in the accelerate-stop distance. However, under the revisions incorporated in §§ 25.107(a) and 25.109(a) as adopted, the revised V_1 speed is equal to V_{EF} plus the speed gained with the critical engine inoperative during the test pilot's recognition-reaction time interval with no further time delay. The accelerate-stop distance for the engine failure case is then determined by accelerating the airplane with one engine inoperative from V_{EF} to the revised V_1 speed and then for an additional 2.0 seconds, before the first retarding means is applied. Under these revisions, a 2.0-second allowance for time delays in service operation is retained, but the total time interval between V_{EF} and application of the first retarding means in the engine failure case would be significantly reduced (for example the reduction could be from about 6 seconds to about 3 seconds for a twin engine airplane). The accelerate-stop distance for the engine failure case would be reduced accordingly. The FAA does not believe that any further revision is warranted because the 2.0-second delay (incorporated into § 25.109 as adopted rather than § 25.107) is necessary to allow for a surprise element and other operational factors not covered in accelerate-stop tests.

One commentator proposed that V_1 speeds be established as recognition speeds for both engine failure and other event cases. However, it is not clear how a recognition time for "other events" would be determined since there is a large variety of possible events that could lead to a rejected takeoff.

Another commentator, in addition to suggesting changes similar to those already made as discussed above, recommended that V_1 be established as a failure recognition speed which would be determined by adding to the speed at which the initial failure is assumed to occur, the time between the failure and the pilot's recognition of the failure (assumed to be 2.0 seconds before his reaction to the failure), and the time not less than 2.0 seconds, to allow for time delays in service under reasonably unfavorable operating conditions. The FAA does not agree that there should be a 2.0-second minimum delay, regardless of the pilot's actual reaction time, in determining V_1 under § 25.107(a), because proposed § 25.109(a) as revised will require that the accelerate-stop distance computations include acceleration of the airplane for 2.0 seconds after V_1 is reached.

This commentator further proposed that closing of the throttles be specified in proposed § 25.109 as the first action to be taken in stopping the airplane, with subsequent actions at intervals of not less than one second. Current § 25.101(h) already requires that the procedures used in determining the accelerate-stop distance must be able to be consistently executed in service by crews of average skill, and must include allowance for any time delays in the execution of the procedures that may be reasonably expected in service. The order in which the retarding devices are applied and the subsequent time delays will be established during type certification under the general provisions of § 25.101(h).

One commentator objected to the requirement in proposed § 25.107(a) that V_{EF} may not be less than V_{MCG} (minimum control speed on the ground) determined under (proposed) § 25.149(e). The commentator stated that it should only be required that V_1 not be less than V_{MCG} because if an engine failure is recognized between V_{EF} and V_1 the takeoff should be aborted. However, under proposed §§ 25.107(a) and 25.109(a), as revised V_1 will be placed at the speed at which the test pilot recognizes and reacts to an engine failure during accelerate-stop tests and the 2.0-second time delay will be inserted after V_1 instead of between V_{EF} and V_1 as proposed. This revision allows V_1 to be very close to V_{EF}. Therefore, the effect on takeoff and accelerate-stop distances of requiring that V_{EF} not be less than V_{MCG} has been significantly reduced because of the deletion of the minimum 2.0-second delay between V_{EF} and V_1. In addition, the FAA believes that V_{EF} should not be less than V_{MCG} so that there will be at least a small margin between V_{MCG} and V_1 to ensure controllability of the airplane at V_1.

One commentator recommended that the proposals containing V_1 and accelerate-stop distances be made retroactive to existing transport category airplanes one year after the date of their adoption. Current § 25.101(h) already provides that the procedures used in determining accelerate-stop distances include allowance for time delays reasonably expected in service. The purpose of the present proposals is to clarify and standardize the method of including an appropriate time delay in the accelerate-stop performance determination for airplanes type certificated in the future.

In regard to proposal 6-2, which would change the definition of V_1 in § 1.2 from "critical engine failure speed" to "takeoff decision speed," one commentator considered the proposed definition to be inadequate because "decision" is an undefined quantity. The commentator recommended that the proposal be revised to state that V_1 means the speed at which the flight crew has recognized an engine failure or other event and takes action either to reject or continue the takeoff. The significance of V_1 with respect to accelerate-stop distance, takeoff distance, and the related operating procedures is explained in the Airplane Flight Manual and the FAA believes it is too complex to be completely described in a brief definition in § 1.2. Accordingly, the proposed amendment of § 1.2 is adopted without substantive change.

The proposals to revise §§ 25.107(a) and 25.109(a) are adopted with the revisions discussed above.

Proposal 6–35. One commentator stated that if the intent of proposed §§ 25.107(d) and (e)(1)(iv) with respect to the engine-out V_{MU} is to ensure controllability, the V_R–5 tests required by § 25.107(e)(3) should be expanded to require the test over the full range of certification conditions and all references to one-engine-inoperative V_{MU} should be deleted from §§ 25.107(d) and (e). The FAA does not agree with this recommendation because it would ignore the performance aspects (thrust-to-weight ratio) of the one-engine-inoperative V_{MU} demonstration.

Another commentator stated that flight test experience has shown that trim and control drag is accounted for with the thrust/weight ratio corresponding to the one-engine-inoperative condition used in the test, and that actual engine-out V_{MU} tests result in the same V_{MU} as tests conducted at the simulated engine-out thrust-to-weight ratio. The FAA agrees, and the last sentence of proposed § 25.107(e)(iv) is deleted. The proposal to amend § 25.107 is adopted with the revision discussed above.

Proposal 6–36 . For comments related to proposed § 25.109(a), see Proposal 6–34.

Proposal 6–37. One commentator agreed with the proposed change to § 25.111(a)(2), which would delete the reference to V_1 and substitute V_{EF} in its place to make § 25.111(a) consistent with proposed § 25.107(a) (Proposal 6–34). However, this commentator did not agree with making the same change to § 25.111(a)(3), and said that the present reference to V_1 in that paragraph is correct for the new definition of V_1 (i.e., as defined in proposed §§ 1.2 and 25.107(a)). The FAA does not agree with the comment on proposed § 25.111(a)(3) because it would leave a gap in the requirements for the speed range between V_{EF} and V_1.

Accordingly, the proposal to amend §§ 25.111(a)(2) and (a)(3) is adopted without substantive change.

Proposal 6–38. Proposed § 25.121(e) would require the determination of the vertical distance required to make a transition from a 3-degree descent path in the landing configuration with the critical engine inoperative to a stabilized climb condition. Several commentators stated that the vertical distance determined in this manner should not be considered a minimum decision height for approaches. The FAA agrees, since the establishment of decision height requires consideration of many operational factors. Some commentators stated that the landing configuration in the proposal is not appropriate for one-engine-inoperative approaches. One commentator recommended that the horizontal as well as the vertical distance for transition to approach climb be determined, and referred to the work of the ICAO Obstacle Clearance Panel on this subject. Another commentator recommended that the required determination take into account the minimum control speed, V_{MC}. In light of the comments received, and after further review, the FAA believes that proposal 6–38 should be withdrawn.

Proposal 6–39. Several commentators objected to the proposal to amend § 25.123(a) on the ground that current § 25.123(a) is conservative and has the advantage of greater simplicity. The FAA agrees and the proposal to amend § 25.123(a) is therefore withdrawn.

Proposal 6–40. One commentator recommended that proposed § 25.143(b) be withdrawn and that current § 25.143(b) be retained on the ground that there are areas within the flight envelope from takeoff to landing where the failure of a second engine cannot be handled smoothly and safely. The commentator also stated that the proposed amendment is vague and could produce confusion with respect to time between failures, and that it could be interpreted to require a combination of double engine failure and configuration changes. The FAA agrees that the proposed rule requires some clarification, but does not believe that the current § 25.143(b) should be retained. With respect to failure of a second engine on airplanes with three or more engines, the FAA believes that failure of a second engine can be reasonably expected in the enroute, approach, and landing stages of flight after failure of one engine earlier in the flight.

Therefore, proposed § 25.143(b) is revised to require consideration of the sudden failure of the second critical engine when the airplane is in a trimmed condition with one engine inoperative in the enroute, approach, and landing configurations. This revision also clarifies the requirement with respect to time between engine failures by providing that the airplane is in a trimmed condition with one engine inoperative when the second engine is failed. In regard to combination of engine failure and configuration changes, it should be noted that the introductory sentence of proposed § 25.143(b) refers to "probable operating conditions," and that some change of configuration may be desirable after engine failure, e.g., retracting the landing gear for a go-around after engine failure in the landing configuration.

Another commentator considered the proposed configuration change requirement to be too general and vague and suggested that the proposed requirement contain certain specific criteria. The commentator also recommended that interpretative material be included in the rule or in the associated Flight Test Guide. The FAA does not agree. The FAA believes that the wording of the proposed rule is clear and would accomplish the intended purpose.

The proposal to amend § 25.143(b) is adopted with the revision discussed above.

No unfavorable comments were received on the proposal to amend § 25.143(c), which would reduce the maximum allowable rudder force for temporary application in meeting the controllability requirements, from 180 pounds to 150 pounds. Accordingly, the proposal is adopted without substantive change. For consistency with § 25.143(c), as adopted, and since flight test experience has shown that 180 pounds may make control difficult for some pilots under some flight conditions, § 25.147(a) is amended by deleting the reference to "180 pounds" and inserting in its place "150 pounds".

Proposal 6–41. One commentator recommended deletion of proposed § 25.149(a), which would require that the method used to simulate critical engine failure must represent the modes of powerplant failure expected in service. The FAA does not agree. This provision is necessary to ensure that the most adverse condition with respect to controllability is considered. To clarify this intent, § 25.149(a) is revised to require consideration of the most critical mode of powerplant failure with respect to controllability expected in service. This commentator objected specifically to dynamic engine cut demonstrations because of the hazards involved. The FAA believes that dynamic effects should be considered during type certification, since they might occur in service operations.

Upon further review, the FAA believes that specific guidance as to the setting of the propeller on propeller-driven airplanes is necessary with regard to proposed § 25.149(c). Current § 25.149(b)(8) specifies the setting of the propeller for reciprocating engine-powered airplanes. Current § 25.149(c)(5) specifies that for turbine engine-powered airplanes, the airplane must be ". . . in the most critical takeoff configuration existing along the flight path . . ." and has been administered to require that the setting of the propeller of turbine engine-powered, propeller-driven airplanes be the same as that specified in current § 25.149(b)(8). Accordingly, current § 25.149(b)(8) is retained and redesignated § 25.149(c)(7), to be applicable to all propeller-driven airplanes.

One commentator stated that the pilot should be provided with information regarding the effects of bank angle on V_{MC}. The FAA does not have enough information at this time to justify the suggested requirement.

Proposed § 25.149(e) would require the determination of a minimum control speed on the ground, V_{MCG}, for use in establishing takeoff speeds under proposed § 25.107 (see Proposal 6–34). One commentator recommended that the second sentence of proposed § 25.149(e) be revised to read "During this demonstration, the permissible lateral deviation of the path of the airplane would be limited to 30 feet." He said that the revision would eliminate the possibility of misinterpretation. The FAA believes that the language of the proposal is clear; however, it may be too restrictive in requiring the ground track to be parallel to or converging toward the centerline of the runway when the airplane is rotated for takeoff, and thereby unnecessarily delay rotation in determining takeoff performance under §§ 25.107(e) and 25.111. Section 25.149(e) is therefore revised to state that the airplane's path, from the point at which the critical engine is made inoperative to the point at which recovery to a direction parallel to the runway centerline is completed, may not deviate more than 30 feet laterally from the centerline. The adopted rule would allow the airplane to be rotated for takeoff before recovery to a direction parallel to the runway centerline is completed; however, it should be noted that it requires that V_{MCG} must be determined to enable the takeoff to be safely continued using normal piloting skill. The commentator also recommended that proposed §§ 25.149(e)(3) and (e)(5) be deleted because flight tests have proven that gross weight and center of gravity have no effect on V_{MCG}. The FAA does not agree. The airplane's acceleration varies with its weight, and this may affect directional control and lateral deviation. The center-of-gravity location may also affect directional stability and control on the ground.

One commentator stated that proposed § 25.149(e) would allow a lateral deviation of 30 feet during the determination of V_{MCG}, whereas the current FAA Flight Test Handbook recommends 25 feet and the Air Force requires 25 feet. The commentator recommended that 25 feet be specified in the adopted rule. The FAA believes that the 30-foot deviation limit will assist in international standardization in this area. In addition it should be noted that § 25.107(a)(1) as adopted (see discussion of Proposal 6-34) requires V_{EF} to be not less than V_{MCG} and V_1 to be greater than V_{EF}, thus providing a small controllability margin at V_1.

Several commentators recommended that the proposal be revised to allow the use of nose wheel steering in the determination of V_{MCG} under § 25.149(e), if control is through the rudder pedals and the demonstration is made on a wet runway. The FAA does not agree. The effectiveness of nose wheel steering depends to a large degree on runway friction characteristics and the load on the nose wheel. Certification tests on a wet runway would not cover the more extreme slippery runway conditions or all possible variations in takeoff conditions and techniques likely to occur in service. The FAA therefore believes that V_{MCG} should be determined without the use of nose wheel steering, as stated in proposed § 25.149(e).

In regard to the airplane configuration used in determining V_{MCG}, one commentator recommended that proposed § 25.149(e)(1) be revised to specify each takeoff configuration instead of the most critical takeoff configuration, to allow a separate V_{MCG} for different flap settings. The FAA agrees that an applicant should be allowed to determine a separate V_{MCG} for different takeoff configurations but believes that the applicant should also have the option of determining a V_{MCG} value for only the most critical takeoff configuration. Proposed § 25.149(e)(1) is revised accordingly.

Proposed § 25.149(e)(2) would require that V_{MCG} be determined with maximum permissible takeoff power or thrust on the operating engines; however, the word "permissible," in relation to power or thrust, is not defined or used elsewhere in the performance and flight characteristics requirements. For consistency with §§ 25.101(c) and 25.149(c)(1), the word "permissible" is replaced by "available" in § 25.149(e)(2) as adopted. It should be noted that § 25.101(c) refers to the propulsive thrust available under the particular flight condition and thus provides for any difference between the takeoff thrust set during takeoff and the thrust available in flight for a go-around.

Proposed §§ 25.149(f), (g), and (h) would require the determination of two new minimum control speeds, V_{MCL} and V_{MCL-2}, associated with an engine failure during landing approaches that are initiated with all engines operating and with one engine inoperative, respectively. One commentator said that these proposals are inconsistent with the V_{MCL} definitions being considered in the development of wet runway landing performance rules. The commentator recommended that these proposals be deleted until an acceptable rational landing rule is established. Another commentator stated that V_{MCL} and V_{MCL-2} would serve no useful purpose and may confuse flight crews. The FAA does not agree with these comments. These proposals are intended to cover the controllability aspects of an engine failure during landing approach. Proposed § 25.149(f) as revised is intended to determine a minimum control speed for the situation where an engine fails after power or thrust has been increased to make a go-around from an approach with all engines operating. For airplanes with three or more engines, proposed §§ 25.149 (g) and (h) as revised are intended to determine a minimum speed for maintaining safe control during the power or thrust changes that are likely to be made following the failure of a second engine during an approach initiated with one engine inoperative. The FAA believes that these proposals, with revisions discussed, should be adopted at this time to provide information for use in pilot training and service operations.

One commentator noted that proposed §§ 25.149(f)(5), (g)(5), and (h)(2) specify "maximum permissible power" in the determination of V_{MCL} and V_{MCL-2}. The commentator recommended that this be changed to "takeoff or maximum permissible power" as used in present § 25.149. Another commentator said that it is not clear whether "maximum permissible thrust" in proposed §§ 25.149(f), (g), and (h) means maximum takeoff (or contingency) thrust, or whether a lower thrust can be scheduled. This commentator also stated that takeoff (or contingency) thrust would represent an increase in severity with respect to both the British Civil Air Regulations and present § 25.149(d), and that the thrust to be associated with recovering control following a sudden engine failure in §§ 25.149(f) and (g) should be the power required for a 3-degree approach, and the thrust range to be associated with maintaining straight flight thereafter should be from minimum power to power for level flight or maximum power, whichever occurs first.

As explained in the preceding discussion of § 25.149(e)(2), current § 25.149(c)(1) uses the words "maximum available takeoff power or thrust". The FAA believes that, for V_{MCL}, the power or thrust condition at the time of engine failure should be the thrust associated with a go-around and therefore believes that maximum available takeoff power or thrust should be prescribed in § 25.149(f) since the approach climb requirements in § 25.121(d) allow use of available takeoff power or thrust. Proposed § 25.149(f) is revised accordingly.

However, since there are no performance requirements for a go-around with two engines inoperative, the FAA believes that the initial power condition at the time of failure of the second engine in § 25.149(g) for V_{MCL-2} should be that for a 3-degree approach with one engine inoperative. This is one of the initial power conditions prescribed in proposed § 25.149(h). In regard to the maximum power or thrust to be applied after the second engine is made inoperative, the FAA believes that the value of V_{MCL-2} to be furnished as information to the pilot should be based on the power or thrust that provides the maximum performance capability of the airplane without exceeding the powerplant limitations, i.e., maximum available takeoff power or thrust at the upper end of the range, and minimum available power or thrust at the lower end of the range. Proposed § 25.149(g) is revised accordingly.

Since V_{MCL} will be determined with maximum available takeoff power, proposed § 25.149(h) is revised so that the requirement of changing the power or the operating engines after failure of the critical engine only applies to V_{MCL-2}.

One commentator said that the critical weight for V_{MCL} can be the lowest weight, when a 5-degree bank angle is used, and he therefore recommended that proposed §§ 25.149(f)(4) and (g)(4) be revised to specify the most unfavorable weight in the range of landing weights, instead of the maximum sea level landing weight (or any lesser weight necessary to show V_{MCL}). The FAA agrees that light weight may be critical for V_{MCL} or V_{MCL-2} but does not believe that the recommended wording change is necessary. The proposal is consistent with current § 25.149(c)(4), and light weight conditions are considered under the current rule.

One commentator stated that the proposal requires determination of V_{MCL} and V_{MCL-2} but does not appear to require that this information be made available to flight crews or that it be used in determining the approach speed. The commentator recommended that the proposal be changed to require that V_{MCL} and V_{MCL-2} be included in the Airplane Flight Manual and also that the landing performance requirements in § 25.125 be amended to take account of V_{MCL}. The FAA does not have sufficient information to justify changing the landing performance requirements in the manner recommended by the commentator. However, information regarding V_{MCL} and V_{MCL-2} would be required to be furnished in the Airplane Flight Manual pursuant to the provisions of § 25.1585 (a)(1).

For a comment related to the clause "either with zero yaw or with an angle of bank of not more than 5 degrees", which is contained in proposed §§ 25.149(e), 25.149(f), and 25.149(g), see Proposal 6–13.

The proposal to amend § 25.149 is adopted with the revisions discussed above.

Proposal 6–42. One commentator stated that the exception in proposed § 25.177(b)(2) for the speed range from V_{MO}/M_{MO} to V_{FC}/M_{FC} should also be applicable to the speed range from 1.2 V_{S1} to V_{MO}/M_{MO}. The FAA does not agree. V_{MO}/M_{MO} is the maximum operating limit speed. Gradual divergence that is easily recognizable and controllable by the pilot is allowed in the speed range above V_{MO}/M_{MO} because it is expected that operation at speeds above V_{MO}/M_{MO} will occur only for brief periods and that flight control demands will in general be limited to the restoration of flight at speeds below V_{MO}/M_{MO}.

Accordingly, the proposal to revise § 25.177(b) is adopted as proposed except that a provision for maximum flap extended speed and maximum landing gear extended speed has been added for clarification and consistency with the present rule.

Proposal 6-43. Proposed § 25.181(b) would require that combined lateral-directional ("Dutch roll") oscillations be positively damped, i.e., diminish after a disturbance, but it does not specify the degree of damping. One commentator recommended that the proposal be revised to state that lateral-directional oscillations should be damped but that neutral damping or mild divergence would be acceptable if it is easily controllable by the pilot. The commentator said the proposal is unnecessarily restrictive following the failure of a stability augmentation device, since the device must be designed to meet § 25.21(e), and that the damping required should be related to the frequency and amplitude of the oscillation, the pilot tasks, and environmental effects. The commentator also said that, if unsatisfactory damping following a failure is confined to an avoidable flight area or configuration and is controllable to return the aircraft to a satisfactory condition for safe flight, the lack of appreciable positive damping may be acceptable. The FAA does not agree with this recommendation. Current § 25.181 requires any short period oscillation to be heavily damped, and the proposal would require that combined lateral-directional oscillations be positively damped instead of heavily damped. The change recommended by the commentator would increase the pilot's tasks and could result in an unsafe situation when operating in rough air. Section 25.672(c) already allows degradation of stability and other flight characteristics after any single failure in a stability augmentation system if the airplane is safely controllable and the resulting stability characteristics allow continued safe flight and landing.

Another commentator recommended that the proposal should be changed to raise the lower limit of the speed range for positive stability from the stalling speed to 1.2 V_{S1}. The proposal is the same as the current rule with respect to the lower speed limit of the speed range for positive stability and the FAA does not have sufficient information at the present time to justify raising the lower speed limit to 1.2 V_{S1}.

The proposal to revise § 25.181 is adopted without substantive change.

Proposal 6-44. One commentator recommended that the proposal to amend § 25.201 and the proposal to amend § 25.207 (Proposal 6-45) be withdrawn in light of current FAA studies on landing distances which may result in a new stall requirement. The FAA does not agree with this recommendation because the proposals for §§ 25.201 and 25.207 deal with stall demonstration and stall warning, and current studies for the landing distance rules do not include changes to §§ 25.201 and 25.207.

Another commentator stated that many modern airplanes are accepted as having correct stalling characteristics even though these occur before reaching the angle of attack for maximum lift, and suggested that the phrase "at an angle of attack measurably greater than that for maximum lift" be deleted from proposed § 25.201(d)(1). Proposed § 25.201(d)(2) sets forth an exception to the requirements of proposed § 25.201(d)(1) (this would be a relaxation of the requirement in current § 25.201(c)(2) with respect to those instances in which the airplane may be considered to be stalled). The FAA does not believe any further relaxation would be justified.

One commentator expressed concern that proposed § 25.201 might result in unwarranted increases in operational speeds and runway length requirements; however, no explanation of this comment was provided. Some operating speeds are affected by stalling speeds which are determined under §§ 25.103, 25.203, and 25.201. Proposed § 25.201(d)(2) provides that for an airplane demonstrating an unmistakable inherent aerodynamic warning in a particular configuration of a magnitude and severity that is a strong and effective deterrent to further speed reduction, the airplane may be considered stalled when it reaches the speed at which the effective deterrent is clearly manifested. (This exception is present in the current rule but is only applicable to those airplanes demonstrating the required degree of warning in all required configurations.) The FAA believes that it is necessary that an applicant be allowed to limit the stall demonstration to the speed where a strong and effective deterrent (such as severe buffeting) is clearly manifested because operation of the airplane at any lower airspeed may be hazardous. Therefore, the FAA believes that any increase in an operating airspeed because a stall demonstration was limited to the airspeed at which there exists an effective deterrent, as provided in proposed § 25.201(d)(2), is justified.

Accordingly, the proposal to amend § 25.201 is adopted as proposed, except that a nonsubstantive change is made to proposed § 25.201(d)(2) to clarify its intent. The proposal to amend § 25.207 is adopted without substantive change.

Proposal 6-45. For comments related to the proposal to amend § 25.207, see Proposal 6-44.

Proposal 6-46. Proposed § 25.233(a) would change the requirements concerning ground looping tendency in cross winds by substituting "25 knots" in place of "0.2 V_{s0}" for the prescribed wind velocity. Several commentators objected to the use of 25 knots for the required wind velocity, stating that the present requirement corresponds to about 20 knots for most airplanes, and that standardizing on a height of 10 meters above the surface for airport wind velocities (see Proposal 6-32 for § 25.21(f)) would also increase the required cross wind component (as compared with the present practice of correcting wind velocity to a height of 50 feet). The FAA agrees that 20 knots would be an appropriate minimum value for the cross wind component; however, this would be less severe than the present rule for airplanes with a stalling speed (V_{s0}) greater than 100 knots. Therefore, § 25.233(a) is revised to replace "0.2 V_s" with "20 knots or 0.2 V_{s0}, whichever is greater, except that the wind velocity need not exceed 25 knots".

One commentator suggested that the rule be written to allow the use of analysis to show acceptable ground handling characteristics for cross wind components greater than 20 knots. The FAA does not agree that analytic methods are reliable for this purpose. (See discussion of Proposal 6-47.)

Proposal 6-47. Proposed § 25.237(a)(1) would establish 25 knots as the minimum cross wind component for landplanes, to be demonstrated on dry runways. Several commentators objected to the use of 25 knots for the required minimum wind velocity. For reasons explained in the discussion of Proposal 6-46, proposed §§ 25.237(a) and (b) are revised, consistent with § 25.233 as adopted, by replacing "25 knots" with "20 knots or 0.2 V_{s0}, whichever is greater, except that it need not exceed 25 knots."

Proposed § 25.237(a)(2) would require that a safe cross wind component be established for wet runways, but would allow this to be determined by analysis in lieu of demonstration. Two commentators recommended that the proposal concerning wet runways be deleted, since there is no definition of "wet," and they considered the current rules for cross wind operation to be adequate for either wet or dry cases. Two other commentators doubted the validity of analytic methods for establishing a safe cross wind component for wet runways. In light of the comments received, and after further review, the FAA believes that proposed § 25.237(a)(2) is premature and it is withdrawn.

Proposal 6-48. Two commentators recommended that proposed § 25.251(e) be revised to prescribe an acceleration of ±0.1 g, instead of ±0.05 g, in defining the onset of buffet. One of the commentators stated that this change would ensure a level of buffet that would be distinguishable under turbulent air conditions. The commentator stated that contrary to the explanation in the notice, test pilots have signified the onset of buffet when the buffet level at a flight station was greater than ±0.1 g, and that defining buffet onset in § 25.251(e) as ±0.05 g would unnecessarily limit the altitude-payload capability of the airplane. After considering the comments received, and after further review, the FAA does not believe it has enough information at this time to specify an acceleration value for the onset of perceptible buffeting which would be applicable to all airplanes. Accordingly, the proposal is withdrawn.

Proposal 6-49. Proposed new § 25.255 would establish requirements for maneuvering and dive recovery characteristics with the airplane out of trim by the amount resulting from a three-second movement of the primary longitudinal trim system at its normal rate with no aerodynamic load, or the maximum mistrim that can be sustained by the autopilot while maintaining level flight in the high speed cruising condition, whichever is greater. One commentator said that the requirement would appear not to apply to a manual trim system, and that this should be made clear. The intent of the proposal is to provide a basic maneuvering stability and dive recovery requirement regardless of the type of trim system used in the airplane.

To make this intent clear, the first sentence of the lead-in of proposed § 25.255 is revised by inserting the parenthetic "(or an equivalent degree of trim for airplanes that do not have a power operated trim system)". In addition, current § 25.655(b) requires that if an adjustable stabilizer is used, it must have stops that will limit the range of travel to the maximum for which the airplane is shown to meet the trim requirements of § 25.161. Therefore, the first sentence of the lead-in of proposed § 25.255 is also revised by inserting an exception indicating that the trim movement need not exceed the range established by stops in the trim system, including those required by § 25.655(b) for adjustable stabilizers. It should be noted that the word "primary" in the first sentence of the lead-in of proposed § 25.255 is being deleted since its usage in this context is inappropriate. The same commentator also said that he does not understand the phrase relating to the autopilot, but believes there is a need for an analysis to show whether greater mistrim can result from autopilot or other system malfunction, or from normal autopilot functioning such as when flying on altitude hold through updrafts. The phrase in the proposal relating to autopilots is intended to provide for circumstances in which the trim system is actuated, either by a runaway or by the pilot, while the autopilot is engaged, and the autopilot is then disengaged when the degree of mistrim reaches the point where the autopilot can no longer hold level flight. The FAA believes that this is an appropriate test criterion. In addition, it should be noted that autopilot malfunctions are covered under § 25.1329.

One commentator recommended that the proposed wording "at its normal rate with no aerodynamic load" in the lead-in of proposed § 25.255 be replaced by "at the rate existing for the specified flight condition." The FAA agrees that where the trim system is designed to vary the rate of trim movement according to the flight condition (e.g., as a function of the dynamic pressure), this variation may be taken into account; however, the effects of aerodynamic loads on trim movement may vary in a complex manner, e.g., with center of gravity, airspeed, and system friction. As stated in the notice, the proposal is intended to simulate a typical out-of-trim condition. The FAA believes that the requirement should be specified so that the required trim change can be determined by a relatively simple and uniform procedure. Accordingly, § 25.255 as adopted is revised to specify a three-second movement of the trim system at the normal rate for the particular flight condition with no aerodynamic load.

One commentator recommended that § 25.255(a) be changed to read: "The slope of the stick force vs. g (curve) for load factors between $-1g$ and $+2.5g$ must be positive at speeds up to V_{FC}/M_{FC} or aural warning (speed) except that a 'flattening' of the stick force gradient or a reduction in stick force is permissible if it does not result in the tendency to overcontrol. Lesser acceleration values may be used at altitudes where buffet envelopes are established in accordance with § 25.251(e)." The FAA disagrees with the recommendation. Current § 25.253(b) already allows M_{FC} to be the same as the Mach number at which effective speed warning occurs for altitudes where Mach number is the limiting factor. At lower altitudes where airspeed is the limiting factor, V_{FC} under § 25.253(b) must be higher than the aural warning speed under § 25.1303(c)(1). Recoveries from severe upsets or evasive maneuvers are likely to be made in this altitude range at speeds above the aural warning speed. Threfore, the FAA believes that the proposed requirement should be met at speeds up to V_{FC}/M_{FC}. In addition, to minimize the possibility of over-control and over-stressing the airplane structure, the FAA believes that a reduction in stick force (negative slope of the stick force per g curve) should not be allowed at speeds up to V_{FC}/M_{FC}. However, it should be noted that flattening of the stick force gradient would be allowed under the proposal as long as the slope is positive.

The changes to proposed § 25.255(a) recommended by this commentator include deleting the proposed requirement for the speed range between V_{FC}/M_{FC} and V_{DF}/M_{DF} (the demonstrated flight dive speed). For this speed range, the proposal states that there may not be reversal of the primary longitudinal control force. Speeds above V_{FC}/M_{FC} have been reached during recovery from upsets in severe turbulence. The FAA believes that reversal of the direction of the control force (as shown on the stick force per g diagram) should not be allowed at speeds up to V_{DF}/M_{DF}, because force reversal on the primary control could be confusing to the pilots and contribute to hazardous over-control in severe turbulence.

Proposed § 25.255(a) provides that acceleration values less than those prescribed may be used at altitudes and speeds where buffet envelopes are established in accordance with § 25.251(e). One commentator objected to this provision and suggested that the proposal be revised to state that, at speeds up to V_{FC}/M_{FC}, the stick force curve must have a positive slope, and at speeds up to V_{DF}/M_{DF} there may not be a reversal of the primary longitudinal control force for normal acceleration values between −1 g and the lesser of 2.5 g and a normal acceleration corresponding, in the particular circumstances of weight, altitude, and air speed or Mach number, to buffeting or other phenomena, of such intensity as to be a strong deterrent to further application of primary longitudinal control force. The FAA does not believe that the buffeting criteria suggested by the commentator would be appropriate, since severe buffeting could mask the normal stick force gradient characteristics.

Another commentator suggested that the proposal be revised to state that "where buffet envelopes are established in accordance with § 25.251(e), the corresponding lesser acceleration values may be used." The FAA disagrees with the recommendation. The suggested wording would indicate that the requirement for positive maneuvering stability (stick force per g) is limited to the load factors within the buffet onset envelopes (i.e., perceptible buffeting) determined under § 25.251(e). However, § 25.251(e) also requires that probable inadvertent excursions beyond the boundaries of the buffet onset envelopes may not result in unsafe conditions. The FAA believes that positive maneuvering stability should be required for inadvertent excursions beyond the buffet onset boundaries, since a pilot is likely to exceed these boundaries in recovering from an upset.

Accordingly, § 25.255 is clarified by deleting the specific acceleration (g) values and exception clause in paragraph (a), and by setting forth a revised exception clause in a paragraph (e) which states that the accelerations need not exceed the maneuvering load factors associated with probable inadvertent excursions beyond the boundaries of the buffet onset envelopes determined under § 25.251(e). For consistency with the structural strength requirements, § 25.255(e) as adopted also states that the accelerations need not exceed the limit maneuvering load factors prescribed in §§ 25.333(b) and 25.337.

In addition, the other paragraphs of proposed § 25.255 have been restructured and redesignated for clarity. The second sentence of proposed § 25.255(d) would provide for the use of longitudinal trim to assist in producing the required 1.5 g for recovery. One commentator suggested that a clause be inserted to require that it be possible to produce at least 1.2 g without use of the longitudinal trim system and without exceeding a longitudinal control force of 125 lbs. The FAA believes that the recommended change is unnecessary because proposed § 25.255(d) already provides that longitudinal trim can only be used to assist in producing 1.5 g if it meets certain requirements.

Proposed § 25.255(d) requires that if the longitudinal trim is used to assist in the dive recovery, it must be shown that the trim can be actuated in the nose up direction with the primary surface (e.g., elevators) loaded to produce the least of the nose up control forces specified in paragraphs (d)(1), (d)(2), and (d)(3). One commentator recommended that proposed paragraph (d)(1) be deleted and that paragraph (d)(2) be changed to "125 pounds." The FAA does not agree. In an upset, the initial attempt at recovery is likely to be made with the primary pitch control, and on some airplane designs the airloads on the horizontal tail surfaces tend to prevent movement of the trim system at high speeds. The change recommended by the commentator assumes, in effect, that the pilots will actuate the trim in time to obtain recovery before they apply more than 125 pounds on the primary control. This may not be a valid assumption in extreme upset conditions.

One commentator stated that it is impracticable to demonstrate 1.5 g, and less than 1 g, at V_{DF}/M_{DF} in a flight test without exceeding V_{DF}/M_{DF}, and that some alleviation should be provided to cover this. Proposed § 25.255(d), which states that it must be possible from an overspeed condition at V_{DF}/M_{DF} to produce at least 1.5 g for recovery by applying not more than 125 pounds of control force, would only require that the test be started at V_{DF}/M_{DF}. With regard to accelerations less than 1 g, the commentator has apparently misinterpreted the requirement of proposed § 25.255(f). The intent of the requirement in proposed § 25.255(f) is that the entry speeds for flight test investigations at acceleration values less than 1 g should be limited to the extent necessary to accomplish a recovery without exceeding V_{DF}/M_{DF}. To clarify this intent, proposed § 25.255(f) is revised and incorporated into § 25.255(e).

Another commentator recommended certain changes in the arrangement of paragraphs in § 25.255 along with other changes already discussed above. The FAA believes, however, that the paragraphs of proposed § 25.255, as revised, are in the most appropriate order for clarity.

One commentator stated that proposed § 25.255 should be changed to be consistent with the manner in which the out-of-trim special condition has been applied in certification tests since 1965. The wording of the special conditions for various airplanes, and of related regulations §§ 25.251 and 25.253, has changed between 1965 and the present time. The proposal in the notice is based on the wording of recent special conditions.

Proposal 6–50. Proposed § 25.703 would require a takeoff warning system to warn the pilots during the initial portion of the takeoff roll if the airplane is in a configuration that would prevent successful completion of the takeoff. One commentator recommended that the proposed requirement for both aural and visual warnings be changed to require either an aural or visual warning. Another commentator questioned the desirability of a visual warning, particularly at night, citing the time that may be lost in searching for a visual warning. The FAA agrees with the latter comment. Accordingly, the requirement for an aural warning is retained and the requirement for a visual warning is withdrawn.

One commentator recommended that the words "including any of the following" (configurations) in proposed § 25.703(a) be changed to "consisting of the following" (configurations). The FAA does not agree since a particular airplane design may incorporate some other variable geometry device that would not allow a safe takeoff when in the wrong position.

The same commentator stated that proposed § 25.703(c), which would require that the means used to activate the system function properly throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested, is superfluous and should be deleted. The FAA believes that this paragraph should be retained to clearly define the scope of the requirements.

This commentator also recommended deletion of proposed § 25.703(d) which would require that the system be designed to provide reliable sensing of an unsafe position of each critical aerodynamic surface. The commentator stated that such a system would be unworkable, over-sophisticated, and could degrade flight safety through numerous nuisance warnings. He pointed out that critical aerodynamic surfaces would include ailerons, rudder, and spoilers, and that "proper" position of such surfaces during takeoff would be affected by cross winds, engine failure, etc. The FAA agrees that the requirements in proposed § 25.703(d) could result in a warning system so complex that its effectiveness may be impaired. Proposed paragraph (d) is therefore withdrawn.

In regard to proposed § 25.703(b), one commentator recommended that consideration be given to a system cutoff at some significant airspeed, e.g., 100 knots. It was stated that any valid warning would probably have sounded by the time that speed is reached and the cutoff would preclude unwarranted aborts due to warning system malfunction at high speeds. Proposed § 25.703(b) would require the warning to continue until the configuration is changed to allow a safe takeoff, the takeoff roll is terminated, or the warning is manually deactivated by the pilot. The FAA agrees that a system cutoff at high speeds should be permitted, but believes that the cutoff should not be set below the V_1 speed, since the takeoff can be rejected within the established accelerate-stop distance from any speed up to V_1. Since the next speed above V_1 that can be sensed by a simple means is V_R (e.g., by nose gear switches), the FAA believes that deactivation of the takeoff warning system should be allowed when the airplane is rotated for takeoff. Proposed § 25.703 is revised accordingly.

With respect to the requirement in proposed § 25.703(b) that the warning must continue until the takeoff roll is terminated, the intention of the proposal was not to require that the warning must continue until the airplane is brought to a full stop, but that it must continue until action is taken by the pilot to terminate the takeoff roll, for example by closing all throttles. Proposed § 25.703(b) is revised accordingly.

Another commentator objected to the proposal, stating that the warning system would eliminate reliance on the checklist and induce more hazards than it is designed to eliminate. The FAA does not agree that the warning system would eliminate reliance on the checklist; instead it would serve as a back-up for the checklist, particularly in unusual situations, e.g., where the checklist is interrupted or the takeoff is delayed. The commentator stated that the additional aural warning system would add to the problem of cockpit confusion caused by the multitude of aural warning requirements. The FAA does not agree since the takeoff warning would occur during the initial portion of the takeoff roll and therefore should not be confused with flight over-speed warning, stall warning, or landing gear warning during approach. The commentator added that it is doubtful if a reliable, practical, safe system can be designed, much less for a cost that would approximate the possible benefits. The FAA does not agree since such systems have been developed and used on relatively complex airplanes. The warning systems can be simpler on airplanes having fewer or less critical variable geometry devices.

One commentator recommended that consideration be given to including unreleased brakes in the takeoff warning system in view of the serious consequences of failing to release brakes fully before takeoff. The FAA does not now have sufficient information to justify adopting the suggestion made by this commentator.

The proposed new § 25.703 is adopted with the revisions discussed above and a nonsubstantive revision for clarity.

Proposal 6-51. One commentator suggested the use of the word "suspended" rather that "silenced" in proposed § 25.729(e)(3). The FAA agrees with this suggestion, since it would result in consistency of wording between this section and proposed § 23.729(f)(1). Section 25.729(e)(3) is revised accordingly.

Proposal 6-52. For comments related to the proposal to revise § 25.1043(b), see Proposal 6-23.

Proposal 6-53. No unfavorable comments were received on the proposal to revise § 25.1501. Accordingly, the proposal is adopted without substantive change.

Proposal 6-54. For comments related to the proposal to revise § 25.1521(e), see Proposal 6-23.

Proposals 6-55 and 2-96. One commentator recommended that proposed § 25.1581(a)(2), which would require that the Airplane Flight Manual contain "Other information necessary for safety," be deleted. He stated that the proposed requirement would be far too broad, and could include all information now provided in the crew operating manual. The FAA agrees that the proposed wording may be too broad, but does not agree that all requirements for additional information should be eliminated. Section 25.1581(a)(2) as adopted requires other information that is necessary for safe operation because of design, operating, or handling characteristics. This wording is the same as current § 25.1581(c), except that the word "unusual" is deleted for the reasons stated in notice.

The same commentator also recommended deletion of proposed § 25.1581(b), which would require that each part of the manual containing required information be approved, segregated, identified, and clearly distinguished from each unapproved part of the manual. The commentator stated that he is not aware of any unapproved sections of the Airplane Flight Manual, and that the proposal implies a crew manual with the FAA limitation data so marked. The FAA does not agree with the recommended deletion of this requirement. The proposed paragraph is the same as current § 25.1581(b), and is intended to cover cases where the applicant desires to include information in the manual that is not required by the FAA.

Proposal 6-55 to amend § 25.1581 is adopted with the revisions discussed above.

The disposition of Proposal 2-96, which proposed to add a new § 25.1581(d) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-55. No unfavorable comments were received on Proposal 2-96 and the proposal to add a new § 25.1581(d) is adopted without substantive change.

Proposal 6-56. For comments related to the proposal to amend § 25.1583, see Proposal 6-23.

Proposals 6-57 and 2-87. No unfavorable comments were received on the proposal to amend § 25.1585. Accordingly, the proposal is adopted without substantive change.

Disposition of Proposal 2-87 to amend § 25.1353 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-57. Proposals 2-39, 2-131, and

2-186 to amend §§ 23.1353, 27.1353, and 29.1353, respectively (Notice 75-10), are substantively identical to Proposal 2-87 and all of these proposals are discussed below.

Commentators suggested that proposed §§ 25.1353(c)(5) and 29.1353(c)(5) be revised by adding the word "or" between paragraphs (c)(5)(i) and (c)(5)(ii) to allow an alternative design. The commentators misinterpreted the proposal. The sections as adopted provide for three alternatives with an "or" between paragraphs (c)(5)(ii) and (c)(5)(iii) and with an "or" understood between paragraphs (c)(5)(i) and (c)(5)(ii).

One commentator suggested that the proposals should be broadened to include nickel cadmium battery installations other than those capable of being used to start an engine or an auxiliary power unit. The proposals apply only to nickel cadmium batteries that are subject to a rapid drain because they are used to start an engine or auxiliary power unit. The FAA does not have enough information to indicate that in other installations the drain on nickel cadmium batteries is sufficiently rapid to require compliance with the proposed provisions.

One commentator objected to proposed §§ 27.1353(f) and 29.1353(c)(5) on the basis that the requirement should be limited to nickel cadmium batteries other than 20-cell batteries and to only certain battery locations. The commentator also stated that the requirement for helicopters should be different from that for airplanes since helicopters are able to execute an emergency landing much quicker than airplanes. The FAA has insufficient information at the present time to warrant any of the distinctions suggested by the commentator.

The FAA believes that the requirement in proposed § 25.1353(c)(5) concerning operating procedures in the Airplane Flight Manual should be transferred to § 25.1585(a), since that section pertains to operating procedures. The proposal for § 25.1353(c)(5) is revised and § 25.1585(a) amended accordingly. The remainder of proposed § 25.1353(c)(5) is redesignated § 25.1353(c)(6) in view of the adoption of a new § 25.1353(c)(5) in Amendment No. 5. The same revisions are also made to proposed §§ 23.1353(f), 27.1353(f), and 29.1353(c)(5), designated as §§ 23.1353(g), 27.1353(g), and 29.1353(c)(6), respectively, and to §§ 23.1585, 27.1585, and 29.1585.

Proposals 6-58 and 2-98. Proposed §§ 25.1587(c)(5) and (c)(6), which would add requirements for information on the vertical distance for transition to approach climb determined under proposed § 25.121(e) (Proposal 6-38), and on the en route net flight path data determined under proposed § 25.123 (Proposal 6-39), are withdrawn in view of the withdrawal of Proposals 6-38 and 6-39.

Disposition of Proposal 2-98 to revise § 25.1587 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-58. No unfavorable comments were received on Proposal 2-98 and it is adopted as proposed except that the reference in proposed § 25.1587(b)(4) to § 25.101(c) is changed to reference §§ 25.101(f), (g), and (h). Current § 25.1587(c)(3), on which proposed § 25.1587(b)(4) is based, was adopted as part of the recodification of Part 4b of the Civil Air Regulations, effective February 1, 1965 (29 FR 18289). Specifically, § 25.1587 replaced § 4b.743 of the CARs and § 4T.743 of Special Civil Air Regulation 422B. Section 4T.743(c), which was replaced by § 25.1587(c)(3), referenced § 4T.111(c) and the requirements of § 4T.111(c) are now contained in §§ 25.101(f), (g), and (h), not § 25.101(c) as the current rule indicates. The purpose of the recodification program was simply to clarify the regulations. No substantive changes, other than relaxatory ones that were completely noncontroversial, were intended. The FAA believes that the change being made is a nonsubstantive editorial change since § 25.1587(c)(3) has been consistently interpreted in accordance with the rule as originally set forth in § 4T.743(c) of Special Civil Air Regulation 422B.

Proposal 6-59. For comments related to the proposal to amend § 27.25(b), see Proposal 6-5. The proposal to amend § 27.25(b) is adopted without substantive change.

Proposal 6-60. For comments related to the proposal to amend § 27.29, see Proposal 6-5.

Proposal 6-61. Proposed new §§ 27.33(e) and 29.33(e) (Proposal 6-77) would require a main rotor low-speed warning for each single engine helicopter and each multiengine helicopter that does not have an approved device that automatically increases power on the operating engines when one engine fails. Several commentators stated that operating experience does not indicate the need for a main rotor low-speed warning and that the instruments furnished the pilot are adequate to monitor rotor r.p.m. safely. One of these commentators also stated that if the warning is set high enough to be effective, the pilot will rely on it in lieu of monitoring rotor r.p.m. as he should and that the warning will activate during low r.p.m. transients which are entirely safe and this may cause pilot action that is unsafe. The commentator stated that since the National Transportation Safety Board (NTSB) has recommended an engine failure warning device on all turbine engines, this proposal should be withdrawn or deferred until action has been taken on the NTSB recommendations. The FAA does not agree. In regard to the comments concerning monitoring of instruments and rotor r.p.m. by the pilot, it should be noted that one of the main reasons for providing rotor low-speed warning is to assist the pilot in maintaining safe rotor speed after an engine failure when his attention is directed to flight path control and emergency procedures. With respect to activation of the warning during low-rotor r.p.m. transients, the FAA believes that the warning can be set to avoid nuisance warnings in normal maneuvers and still meet the requirements of this section. The NTSB Release for Safety Recommendations A-75-72 and 73, issued September 2, 1975, recommended that Parts 27 and 29 be amended to require that all turbine engine-powered helicopters be equipped with a prominent engine-out visual warning system and an aural warning system which can be heard with or without the use of a headset. The FAA believes, as stated in its response to the NTSB, that the proposed requirement for rotor low-speed warning is more desirable than an engine-out warning since a rotor low-speed warning would warn the pilot of an unsafe low rotor speed due to any cause, including engine failure, and will continue the warning function during power-off descent and landing.

One commentator noted that the FAA has imposed special conditions requiring engine-out warnings on certain turbine engine-powered helicopters, and stated that engine-out warnings should not be required in addition to rotor low-speed warning. The FAA does not believe it will be necessary to issue a special condition requiring installation of an engine-out warning on those helicopters with a rotor low-speed warning.

One commentator objected to the deletion of §§ 27.33(b)(3) and 29.33(b)(3). Current §§ 27.33(b)(1), (b)(2), and (b)(3) (and §§ 29.33(b)(1), (b)(2), (b)(3)) provide, for all rotorcraft, three alternative methods for showing that main rotor speeds substantially less than the minimum approved main rotor speed will not occur under any sustained flight condition with power on. One of the alternatives, paragraph (b)(3), is to provide adequate means to warn the pilot of unsafe main rotor speeds, but the proposal would delete this paragraph, thus requiring all rotorcraft to comply with paragraph (b)(1) or (b)(2). This was not the intent of the proposal. Accordingly, §§ 27.33(b)(3) and 29.33(b)(3) are retained. In addition, for clarification, the lead-in of §§ 27.33(b) and 29.33(b) are revised so that they are only applicable to rotorcraft that are not required to have a main rotor low-speed warning under § 27.33(e) or § 29.33(e), respectively.

Proposal 6-62. Two commentators objected to the proposals for §§ 27.45 and 29.45, stating that the basis for humidity levels has not been determined and varies between engines. These commentators further stated that there is no industry agreement on the effect of humidity on power or that humidity has a significant effect on power. The effects of humidity on the power of reciprocating engines are well understood and are generally the same between engine types. The effects of humidity on the power or thrust of turbine engines may differ between engine types. The proposal, however, establishes a reference humidity structure for the development of rotorcraft performance data. It does not prejudge the nature of the corrections, if any, which may be required. Each turbine engine must be evaluated to determine the effect of humidity on thrust or power, and, where rotorcraft performance is affected, it must be based on the humidity reference condition.

One commentator objected to the proposals on the basis that the humidity reference for turbine engine-powered rotorcraft may not be representative of average humidity conditions encountered in service. No safety problem has been identified with the use of the proposed humidity reference in the type certification of transport category airplanes, and the reference is considered equally valid for the type certification of rotorcraft.

One commentator questioned why a reciprocating engine-powered rotorcraft would be required to use a humidity correction different from that for turbine engine-powered rotorcraft. The humidity correction proposed for reciprocating engine-powered rotorcraft is similar to the current requirements for reciprocating engine-powered transport category airplanes and the proposed humidity correction for turbine engine-powered rotorcraft is similar to the current requirements for turbine engine-powered transport category airplanes, and the requirements for transport category airplanes have been administered without difficulty. In addition, the humidity correction requirements for turbine engine-powered rotorcraft are based on the fact that the power or thrust of turbine engines diminishes significantly as the ambient atmospheric temperature is increased. Power or thrust variations related to humidity could therefore have an adverse effect upon safety at temperatures above standard.

The proposal to revise § 27.45 and the proposal to amend § 29.45 are adopted without substantive change.

Proposals 6–63 and 2–100. Under proposed § 27.65(b)(2), if the never-exceed speed V_{NE} is less than the best rate-of-climb speed V_Y at any altitude within the range for which certification is requested, the steady rate of climb must be determined over the entire range of weights, temperatures, and altitudes for which certification is requested. One commentator recommended that the rate of climb information be required only for the range of altitudes where V_{NE} is less than V_Y, instead of the entire range of altitudes. The FAA disagrees. The climb performance and speed of a helicopter may change significantly below, as well as above, the altitude at which V_{NE} is less than V_Y. However, after further review, the FAA believes that it is only necessary that climb data be determined over the range of altitudes from 2,000 feet below the altitude at which V_{NE} is equal to V_Y up to the maximum altitude for which certification is requested. The proposal to amend § 27.65 is revised accordingly.

In addition, proposed § 27.65(b)(2)(i) is revised to allow the rate-of-climb to be determined at the climb speed selected by the applicant (instead of the most favorable climb speed) at or below V_{NE}. The FAA believes that the proposed paragraph (b)(2)(i) would impose an unnecessary burden on the applicant and result in complex operating information, since the most favorable climb speed may be a function of several variables.

Disposition of Proposal 2–100 to amend § 27.65(a)(2) (Notice 75–10) was deferred so that it could be considered in connection with Proposal 6–63. No unfavorable comments were received on the proposal to amend § 27.65(a)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 6–64. Proposed § 27.67(c) would require the determination of the one-engine-inoperative steady rate of climb with maximum continuous power on the operating engines, and (for helicopters for which certification for the use of 30-minute power is requested) at 30-minute power. One commentator said that there is no need to show the climb performance data for both the maximum continuous and 30-minute power levels and, therefore, the word "and" preceding the parenthetical expression should be changed to "or". The FAA does not agree. Even though an applicant may request certification for the use of 30-minute power, climb performance data for maximum continuous power should be furnished to the pilot for use in operations that may require more than 30 minutes to reach a safe landing area after failure of one engine, e.g., over-water operations. Accordingly, § 27.67(c) is adopted without substantive change.

Proposal 6–65. No unfavorable comments were received on the proposal to revise § 27.75(a)(2)(ii). Accordingly, the proposal is adopted without substantive change.

Proposal 6–66. No unfavorable comments were received on the proposal to amend § 27.143. Accordingly, the proposal is adopted without substantive change.

Proposal 6–67. No unfavorable comments were received on the proposal to revise § 27.175(c). Accordingly, the proposal is adopted without substantive change.

Proposal 6–68. For comments related to the proposal to revise § 27.1043(b), see Proposal 6–23.

In addition, a nonsubstantive editorial change is being made to the lead-in of § 27.1043(a) to reference § 27.1041(b) instead of § 27.104(b).

Proposal 6–69. No unfavorable comments were received on the proposal to revise § 27.1501. Accordingly, the proposal is adopted without substantive change.

Proposals 6–70 and 2–135. Disposition of Proposal 2–135 to amend § 27.1545 (Notice 75–10) was deferred so it could be considered in connection with Proposal 6–70 to amend § 27.1505. No unfavorable comment was received on Proposal 2–135. Accordingly, the proposal is adopted without substantive change.

Proposed §§ 27.1505(c) and 29.1505(c) (Proposals 6–70 and 6–84, respectively) would allow the establishment of a never-exceed speed, V_{NE} (power-off), that is less than V_{NE} with power on, if V_{NE} (power-off) is not less than a speed midway between the power-on V_{NE} and the speed for maximum range in autorotation at maximum weight. One commentator recommended that "V_Y or the climb speed selected by the applicant in demonstrating compliance with the climb requirements" be inserted in proposed § 27.1505(c) in place of the speed for maximum range in autorotation. The commentator stated that since determination of the speed for maximum range in autorotation is not presently required, the substitution of the climb speed (which is determined under the climb requirements in §§ 27.65 or 27.67) would accomplish the intent of placing a lower limit on V_{NE} (power-off) without unnecessary additional demonstration requirements.

After further consideration, the FAA believes that the speed used in determining climb performance (one-engine-inoperative climb performance, if applicable) should be used in establishing a V_{NE} (power-off) for both Part 27 and 29 helicopters, instead of the speed for maximum range in autorotation at maximum weight. The speed midway between power-on V_{NE} and the appropriate climb speed is expected to be high enough to provide the pilot with an adequate range of speeds and glide angles during autorotation. In addition, the determination of V_{NE} (power-off) will be based on information already required to be furnished by the applicant which would not be the case if the speed for maximum range in autorotation were prescribed since it is only required to be determined for certain Part 29 Category B helicopters. The proposals to amend §§ 27.1505 and 29.1505 are revised according

Proposal 6–71. For comments related to the proposal to add a new § 27.1521(f), see Proposal 6–23.

Proposal 6–72. No unfavorable comments were received on the proposal to add a new § 27.1527. Accordingly, the proposal is adopted without substantive change.

[For discussion concerning the amendment of § 27.1545, see Proposals 6–70 and 2–135.]

Proposals 6–73, 2–139 and 2–140. No unfavorable comments were received on Proposal 6–73 to amend § 27.1581. The proposal is adopted without substantive change, except that proposed § 27.1581(a)(2) is revised in accordance with the discussion of the proposal to amend § 25.1581 (Proposal 6–55).

Disposition of Proposals 2–139 to amend § 27.1581 and 2–140 to amend § 27.1587 was deferred so that these proposals could be considered in connection with Proposal 6–73. No unfavorable comments were received on Proposal 2–139 or Proposal 2–140. Proposal 2–139 to amend § 27.1581 is adopted without substantive change. For reasons that are stated in the discussion of Proposal 6–23 for § 23.1521(e), Proposal 2–140 to amend § 27.1587 is revised by adding a new § 27.1587(a)(2)(iii) requiring information on the maximum ambient atmospheric temperature at which compliance with the cooling requirements was shown. Additionally, the parenthetical phrase "(if provided)" is deleted from § 27.1587(b) since the amendment to § 27.1581 requires that a Rotorcraft Flight Manual be furnished for each rotorcraft. The proposal to amend § 27.1587 is adopted with the changes discussed above.

Proposal 6–74. For comments related to the proposal to amend § 27.1583, see Proposal 6–23.

Proposals 6–75 and 2–131. Proposed §§ 27.1585(c) and 29.1585(c) would require the operating procedures section of the Rotorcraft Flight Manual to contain information on the procedures for reducing airspeed to V_{NE} (power-off) for helicopters for which a V_{NE} (power-off) is established under §§ 27.1505(c) and 29.1501(c), respectively. One commentator stated that he did not favor systematically placing explicit engine, altitude, and V_{NE} (power-off) limitations in the "limitations" chapter of the Flight Manual. The commentator apparently misinterpreted the proposal, as it would affect only the operating procedures section, not the limitations section. The commentator also stated that these explanations should only be required when they bring significant information to the pilot and when the limitation results from an indirect and not an obvious cause. The

FAA believes that in view of the surprise element that may be associated with engine failure in service operations, the procedure for reducing airspeed to not more than V_{NE} (power-off) should be furnished for each helicopter for which a V_{NE} (power-off) is established. Accordingly, the proposals for §§ 27.1585(c) and 29.1585(c) are adopted without substantive change.

Disposition of Proposal 2-131 to amend § 27.1353 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-73. For comments related to proposed § 27.1353(f) and for an explanation of the revision to proposed § 27.1353(f), see the discussion of Proposal 2-87 under Proposal 6-57.

Proposal 6-76. For comments related to the proposal to amend § 29.29, see Proposal 6-5.

Proposal 6-77. For comments related to the proposed amendment of § 29.33, see Proposal 6-61 for § 27.33.

Proposal 6-78. For comments related to proposed § 29.45, see Proposal 6-62.

Proposal 6-79. One commentator recommended that proposed § 29.65(c) be revised to require climb data only for those altitudes where V_{NE} is less than V_y at sea level. For a discussion of this comment and the explanation for the revisions to proposed § 29.65(c), see Proposal 6-63. This commentator also stated that proposed § 29.65(c) is superfluous for Category B rotorcraft since it duplicates the requirement of proposed § 29.65(a)(4). The FAA agrees that some clarification is needed and proposed § 29.65(a) and (c) are revised to list all of the Category B requirements in paragraph (a) and to make paragraph (c) applicable only to Category A helicopters. For an explanation of the revisions to proposed § 29.65(c)(1), see the discussion of the revision to proposed § 27.65(b)(2)(i) under Proposal 6-63. Accordingly, the proposal is adopted with the revisions discussed above and under Proposal 6-63.

Proposal 6-80. No unfavorable comments were received on the proposal to amend § 29.143. Accordingly, the proposal is adopted without substantive change.

Proposal 6-81. No unfavorable comments were received on the proposal to revise § 29.175(c). Accordingly, the proposal is adopted without substantive change.

Proposal 6-82. For comments related to the proposal to revise § 29.1043(b), see Proposal 6-23.

Proposal 6-83. No unfavorable comments were received on the proposal to revise § 29.1501. Accordingly, the proposal is adopted without substantive change.

Proposals 6-84 and 2-188. For comments related to Proposal 6-84 to amend § 29.1505, and for an explanation of the revisions to proposed § 29.1505(c), see Proposal 6-70.

Disposition of Proposal 2-188 to amend § 29.1545 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-84 to amend § 29.1505. No unfavorable comments were received on Proposal 2-188. Accordingly, the proposal is adopted without substantive change.

Proposal 6-85. For comments related to the proposal to revise § 29.1521(e), see Proposal 6-23.

Proposal 6-86. No unfavorable comments were received on the proposal to add a new § 29.1527. Accordingly, the proposal is adopted without substantive change.
[For discussion concerning the amendment of § 29.1545, see Proposals 6-84 and 2-188.]

Proposals 6-87 and 2-192. Proposal 6-87 proposed to revise § 29.1581(a) and (b) and to delete § 29.1581(c) and mark it "[Reserved]." Disposition of Proposal 2-192 to add a new § 29.1581(d) (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-87.

No unfavorable comment was received on Proposals 6-87 or 2-192. These proposals to amend § 29.1581 are adopted without substantive change except that proposed § 29.1581 (a)(2) is revised in accordance with the discussion of the proposal to amend § 25.1581 (Proposal 6-55).

Proposal 6-88. For comments related to the proposal to amend § 29.1583, see Proposal 6-23.

Proposals 6-89 and 2-186. For comments related to Proposal 6-89 to add a new § 29.1585(c), see Proposal 6-75.

Disposition of Proposal 2-186 to amend § 29.1353 (Notice 75-10) was deferred so that it could be considered in connection with Proposal 6-89. For comments related to proposed § 29.1353(c), see the discussion of Proposal 2-87 under Proposal 6-57.

Proposal 6-90. No unfavorable comments were received on the proposal to amend § 91.31. Accordingly, the proposal to amend § 91.31 is adopted without substantive change.

Proposal 6-91. The proposal to amend § 91.37 was made to implement Proposals 2-49, 2-51, 2-52, and 2-93 to amend §§ 25.105, 25.125, 25.241 and 25.1533, respectively, contained in Airworthiness Review Notice No. 2 (Notice 75-10). Since the proposed amendments to Part 25 have been withdrawn (41 FR 55454), Proposal 6-91 is also withdrawn.

Proposal 6-92. Proposed § 121.141(b) would authorize an air carrier to revise the operating procedures and the format of the performance data for the applicable Airplane or Rotorcraft Flight Manual and include the revised information in the operator's manual required by § 121.133, if the revised procedures and performance data presentation are approved by the Administrator and are clearly identified as flight manual requirements. One commentator said that there was no need for the identification of the flight manual material. This requirement is in the current rule and the FAA does not have sufficient information at the present time to justify deleting it, especially with regard to the operating limitations.

The commentator also suggested that the second sentence of proposed § 121.141(b) would be clarified by inserting a clause indicating that if the certificate holder elects to carry the manual required by § 121.133, he must retain all of the limitations section (of the flight manual) as written, unless deviations are specifically authorized by the Administrator. The FAA does not believe that the suggested change is necessary or appropriate. Proposed § 121.141(b) would not authorize a change in the substance or presentation of the operating limitations required for the applicable flight manual. Accordingly, the proposal to revise § 121.141(b) is adopted without substantive change.

DRAFTING INFORMATION

The principal authors of this document are Paul C. Spiess and Charles J. Maple, Flight Standards Service, and Keith S. May, Office of the Chief Counsel.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 1, 21, 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations are amended, effective March 1, 1978.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); and sec. 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE.—The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11821, as amended by Executive Order 11949, and OMB Circular A-107.

Amendment 25–43

Transport Category Airplanes—Pitot Heat Indication Systems

Adopted: March 6, 1978 **Effective: April 12, 1978**

(Published in 43 FR 10338, March 13, 1978)

SUMMARY: This amendment adds requirements for the installation of a pitot heat indication system for the type certification of transport category airplanes having flight instrument pitot heating systems and for the installation, within three years, of a pitot heat indication system in all transport category airplanes equipped with flight instrument pitot heating systems. The amendment is based on service experience that indicates that pitot heat indication systems are needed in transport category airplanes having flight instrument pitot heating systems to provide greater assurance that incidents and accidents, caused by pilot reliance on faulty flight data instrumentation indications resulting from ice blockage of pitot ports, do not occur.

FOR FURTHER INFORMATION CONTACT:

Raymond E. Ramakis
Regulatory Projects Branch
Safety Regulations Division
Flight Standards Service
Federal Aviation Administration
800 Independence Avenue, SW
Washington, D.C. 20591
telephone (202) 755–8716

SUPPLEMENTARY INFORMATION:

BACKGROUND AND DISCUSSION OF COMMENTS

This amendment is based on a Notice of Proposed Rule Making (Notice 76–12) published in the Federal Register on April 22, 1976, (41 FR 16827). Except as discussed herein, the reasons for this amendment are the same as those contained in Notice 76–12.

Interested persons have been afforded an opportunity to participate in the making of this amendment and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rule based upon the relevant comments received and upon further review within the FAA. The significant public comments and noneditorial changes to the proposed rule are discussed below.

The majority of the comments received in response to Notice 76–12 were opposed to the proposed requirement for a pitot heat indication system. These commentators asserted that a properly trained pilot following proper checklist procedures would not leave the pitot heat switch turned off, when it should be on, that such a pilot would be able to recognize incorrect flight data caused by an inoperative pitot heating element and resultant pitot tube ice accumulation, and that, after recognition such a pilot would use other flight deck instrumentation to continue safe flight. These commenators recommended that the FAA encourage pilot professionalism and the use of proper checklist procedures instead of requiring the addition of an unnecessary and costly indicator to the already too numerous indicators, both visual and aural, that are installed on the flight deck. While the FAA agrees with the need for proper training and the use of proper flight deck checklist procedures, experience indicates that human error is likely to continue to occur and that with respect to pitot heating systems this could and has led to disastrous results. The addition of a pitot heat indication system while not guaranteeing against human error will provide additional assurance that pilots will become aware as early as possible of potentially dangerous situations. Considering the benefits expected and the relatively limited cost involved in the installation of a pitot heat indication system, the FAA believes the requirement to be warranted.

A number of commentators suggested the proposal be revised to permit the use of alternate indicating systems. Among the alternatives suggested were pitot heat element failure warning indicators, ammeters to measure current in pitot heat elements, and indicators to warn of ice accumulation at the pitot ports. In addition to being beyond the scope of Notice 76-12, the FAA does not believe any of these suggested alternate systems to be equivalent to the system proposed with respect to certain necessary characteristics. These alternates either provide no effective indication of whether the pitot heating system is switched on, provide a display that can be easily misinterpreted or overlooked by a flight crew, or provide an indication at a time after flight instrumentation indications have been adversely affected.

Several commentators pointed out that warning lights, which are usually red in color, are used only to provide an indication to the flight crew that a very serious situation exists that requires immediate corrective action. The commentators contended, and the FAA agrees, that the existence of an inoperative pitot heating system is not such a situation. Based on these comments, proposed § 25.1326(a) has been revised to change the required color of the indication light to amber, a color used to alert the flight crew of a less serious situation. In addition, proposed §§ 25.1326 and 91.50 have been revised to redesignate the name of the required system as a "pitot heat indication system".

As an alternative to requiring an indication for an inoperative pitot heating system, one commentator suggested that high reliability pitot heating elements could be required. The FAA does not agree. The reliability of pitot heating elements has not reached a level that would, for the reasons previously discussed, negate the need for an indication system.

A large number of commentators argued that the proposal was not consistent with the design of modern transport category airplanes that have master caution lights and annunciator panel displays and that the proposal should be revised to allow the incorporation of the pitot heat indication system into the existing displays. In this connection, the commentators stated that the proposed requirement, contained in § 25.1326(b), that the indicator be adjacent to the pilot in command airspeed indicator, and the proposed requirement, contained in § 25.1326(d), that the indicating light not be extinguishable when a pitot heating element is inoperative, could not be met with existing master caution light and annunciator panel display. In addition, with respect to proposed § 25.1326(d), one commentator argued that an unnecessary battery drain would result from the proposal that could be hazardous during power-out conditions. The FAA agrees that the required pitot heat indication system should be allowed to be a part of the master caution light and annunciator panel display. This type of display is extremely effective because of its central location and the ease with which it can be checked by the flight crew. Accordingly, proposed §§ 25.1326(b) and (d) have been deleted. In addition, consistent with these changes, proposed § 25.1326 has been revised to provide that the required indication must be to a flight crewmember instead of the pilot. These changes also respond to a comment that the proposal went too far in dictating design.

One commentator questioned the requirement of proposed § 25.1326(c) which refers to pitot heating system switch positions. The commentator pointed out that on many airplanes the pitot heating system activates automatically and there exists no "switch". Based on this comment, the proposal has been revised to more clearly cover automatic switches.

One commentator pointed out that some airplanes have several pitot heating elements and questioned whether under proposed § 25.1326 an indicator would be required for each of these. As proposed the pitot heat indication system was required to provide an indication of an inoperative pitot heating system. Based on this comment, proposed § 25.1326 (c) (§ 25.1326(b) as adopted) has been revised to make it clear that the indication is required irrespective of which pitot heating element is inoperative. Another commentator argued that the pitot heat indication system should indicate to the pilot which pitot heating element is inoperative. The FAA does not agree with this comment. Once the pilot is aware that there is an inoperative pitot heating element, the pilot can utilize other available instrumentation to determine which, if any, flight instruments are accurate and take appropriate action. Therefore, separate pitot heat indications are not necessary.

Based on several comments proposed § 25.1326(e) has been deleted. That provision is adequately covered under § 25.1301.

Several commentators objected to the provision contained in proposed § 91.50 that would require the installation of pitot heat indication systems in all transport category airplanes within three years. These commentators argued that service experience did not justify the adoption of the rule and that if the rule were to be adopted it should only apply to air carriers, air taxis, and commercial operators, or only to newly manufactured airplanes. The FAA disagrees. Contrary to the claims of the commentators, service experience justifies the adoption of the rule. At least one accident and a number of incidents have been reported that might have been avoided if a pitot heat indication system were installed, and the FAA believes that accidents and incidents will be avoided in the future by the adoption of this amendment. With respect to the operations involved, the FAA is unaware of any data or information to indicate that air carriers, air taxis, or commercial operators are any more susceptible than general aviation operators to the problems at which this amendment is directed. Moreover, due to the relative inexpense of the required indication system, the FAA does not believe restricting the retrofit rule to certain transport category airplanes is justified when the safety benefits are considered.

One commentator argued that 5 years would be necessary to install the pitot heat indication systems under proposed § 91.50. Another commentator stated that the three years provided in the proposal was too lengthy a period of time. In this connection, sufficient time is needed for the production, procurement, and installation of the required indication system. The FAA believes the three years proposed is a realistic time for accomplishing these tasks. However, the FAA recognizes that conditions beyond the control of an operator can occur to delay compliance with the rule. This could be the case even though a good faith effort was made by an operator to comply. Because of this, the proposal has been revised to provide, under appropriate circumstances, for a limited extension of the compliance date in accordance with a schedule acceptable to the FAA.

Many commentators objected to proposed §§ 91.50(b) and (c) which would have required the termination of a flight at the nearest suitable airfield if a pitot heating system became inoperative during flight and would have only permitted flights to a base for repair if the actual or forecasted free air temperature was above 32 degrees F. These commentators argued that the proposal could create other hazards by requiring landings at unfamiliar airports and that the altitudes permitted for flights to repair bases under the 32 degree F temperature criteria were unrealistically low. The FAA agrees with these comments. A pilot made aware of a malfunctioning pitot heating system would be able to safely continue operations in accordance with procedures with which pilots are aware. These procedures are contained in airplane flight manuals and minimum equipment lists. Moreover, many transport category airplanes are equipped with dual pitot and flight instrumentation systems and angle of attack indicators to assist the pilot in safely operating an aircraft with a malfunctioning pitot heating system. Accordingly, proposed §§ 91.50(b) and (c) have been deleted.

One commentator suggested that a pitot heat indication system should be required in each aircraft approved for operations under instrument flight rules (IFR). The FAA does not agree. In addition to the comment being beyond the scope of the notice, the FAA does not believe the benefits to be expected from the commentators' suggestion justify its adoption.

The FAA has determined, based on an evaluation of the expected benefits and other impacts on the public and private sectors, that the adoption of this amendment will result in greater assurance that pilots of transport category airplanes will not be dangerously misled by faulty flight instrument indications caused by pitot tube ice accumulation. Based on service experience and other information available, it is estimated that over a five year period approximately 140 lives may be saved by this amendment with the cost of equipment installation being between $500 and $700 for each of the approximately 4300 airplanes covered by the amendment.

DRAFTING INFORMATION

The principal authors of this document are Mr. Thomas Ryan, Flight Standards Service, and Mr. Samuel Podberesky, Office of the Chief Counsel.

THE AMENDMENT

Accordingly, Parts 25 and 91 of the Federal Aviation Regulations (14 CFR Parts 25 and 91) are amended effective April 12, 1978.

Secs. 313(a), 601, 603, and 604, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, and 1424); Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).

The FAA has determined that this document does not contain a major proposal requiring preparation of an Economic Impact Statement under Executive Order 11821, as amended by Executive Order 11949, and OMB Circular A-107.

Amendment 25–44

Operations Review Program; Amendment No. 6: General Operating and Flight Rules and Related Airworthiness Standards and Crewmember Training

Adopted: September 28, 1978 **Effective: December 5, 1978**

(Published in 43 FR 46230, October 5, 1978)

SUMMARY: The purpose of these amendments is to update and improve certain requirements applicable to aircraft, training programs, and airmen. These amendments are part of the Operations Review Program.

FOR FURTHER INFORMATION CONTACT:

Mr. D.A. Schroeder, Safety Regulations Division, Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591; telephone: 202–755–8715.

SUPPLEMENTARY INFORMATION:

HISTORY

These amendments are the sixth in a series of amendments to be issued as part of the Operations Review Program. The following amendments of the series have previously been issued as part of the Operations Review Program:

Title	*FR Citation*
Clarifying and Editorial Changes	(41 FR 47227; October 28, 1976)
Rotorcraft External-Load Operations	(42 FR 24196; May 12, 1977 amended by 42 FR 32531; June 27, 1977)
Airspace, Air Traffic and General Operating Rules	To be issued at a later date)
Development of Major Repair Data	(43 FR 3084; January 23, 1978)
Miscellaneous Amendments	(43 FR 22636; May 25, 1978)
Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft	(43 FR 22643; May 25, 1978 amended) by 43 FR 28403; June 29, 1978)

These amendments are based on a Notice of Proposed Rule Making (Notice 77–20) published in the Federal Register on September 1, 1977 (42 FR 44204). All interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review by the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below these amendments and reasons for their adoption are the same as those contained in Notice 77–20.

DISCUSSION OF COMMENTS

The following discussions are keyed to like-numbered proposals in Notice 77–20 and amendments to §§ 121.417, 121.437 and 121.439. Since these amendments to §§ 121.417, 121.437 and 121.439 are clarifying and relaxatory in nature and do not impose a burden on the public, I find that notice and public procedure are unnecessary and that the amendments may be effective without notice.

Proposal 6-1. Proposed § 91.33(b)(12) would require that safety belts have metal to metal buckles or latching devices. Implementation of this amendment necessitates corollary amendments to the airworthiness provisions of §§ 23.1413, 25.1413, 27.1413 and 29.1413.

Most commenters favored the proposal with some of the commenters suggesting various effective dates for compliance, ranging from one to five years instead of the two-year period proposed. These suggestions were based on consideration of equipment availability and the economic burden of purchasing the new type safety belts. Considering these comments, the FAA concluded that a three-year period for compliance will suffice and the final rule is amended accordingly. One commenter asked whether the "metal to metal" requirement applied to both buckles and latching devices. After further review, the FAA believes that the requirement could be misinterpreted. Since a "buckle" is a "latching device", the word "buckle" is deleted in the rule.

One commenter noted that current § 91.33(b)(12) uses the plural form when referring to "occupants" and "belts". Since it was not FAA's intention to change the current rule in this regard, the plural form is retained.

Proposal 6-2. The proposed revision of § 25.1413 would reflect, in the airworthiness standards, amendments made to § 91.33. See the discussion for Proposal 6-1.

Proposal 6-3. The proposed revision of § 27.1413 would reflect, in the airworthiness standards, amendments made to § 91.33. See the discussion for Proposal 6-1.

Proposal 6-4. The proposed revision of § 29.1413 would reflect, in the airworthiness standards, amendments made to § 91.33. See the discussion for Proposal 6-1.

Proposal 6-5. The proposed revision to § 91.4 would have required a person who releases an aircraft for flight to another person to first determine who intends to serve as pilot in command and to then determine that the pilot in command has current certificates and ratings as required in the regulations.

A large majority of the comments received were unfavorable. Many commenters objected to the proposal on the basis that current rules make the pilot responsible for being properly certificated and rated for the operation intended and the implementation of one regulation to assist in the enforcement of another is not only unnecessary but would impose an economic burden on the industry.

One commenter said the added responsibility imposed upon the "releasor" would involve third parties in possible litigation and the additional inspections would not bring about an increase in safety commensurate with the effort required. Another commenter questioned whether, in light of the wording of § 61.3(h) which limits who can request a person to present his certificate for inspection, the Administrator can, in another rule, designate inspection responsibility to everyone who uses, causes to use, or authorizes the use of aircraft.

A few commenters called attention to the fact that it is just good business to assure that the person to whom they lease aircraft is properly certificated, but there is not sufficient justification to make the lessor responsible for determining all aspects of a pilot's currency.

After consideration of all the comments received and after further review, the FAA believes that there exists insufficient justification to amend the regulations as proposed. Accordingly, the proposal to amend § 91.4 is withdrawn.

Proposal 6-6. Current § 91.14 requires the pilot in command to ensure that each person on board has been notified, before each takeoff and landing, to fasten that person's safety belt. The proposal would require the pilot in command of the aircraft to ensure that each person on board is briefed on how to fasten and unfasten that person's safety belt.

A number of commenters incorrectly concluded that the proposed rule would require the pilot in command to personnally conduct the briefing. The proposed rule would only require the pilot in command to ensure that the passengers are briefed.

One commenter stated that the pilot in command could brief the passengers in the event of an emergency. The FAA believes that, when an emergency develops, the pilot in command would not have the time to brief passengers on how to buckle and unbuckle their safety belts.

A few commenters stated that anybody familiar with automobile seat belts should know how to fasten and unfasten airplane safety belts and, therefore, the briefing is unnecessary. The FAA does not agree. Certain aircraft safety belts are different from those used in automobiles and it cannot be assumed that all passengers are familiar with automobile safety belts.

Since the pilot in command is currently responsible to ensure that persons are notified to fasten their safety belts, the FAA believes that little additional effort will be involved for the pilot in command to also ensure that persons on board are briefed on how to fasten and unfasten their safety belts. Accordingly, § 91.14 is amended as proposed.

Proposal 6–7. Current § 91.21 prohibits a person from operating a civil aircraft for flight instruction unless that aircraft has fully functioning dual controls. The proposed rule would allow the use of a single, functioning, throwover control wheel for instrument flight, instrument flight instruction and simulated instrument flight. The FAA received a large number of favorable responses to this proposal and it is adopted without change.

Proposal 6–8. This proposal would move the 30 minute VFR day fuel reserve requirement, now prescribed in § 91.207 (which applies to large and turbojet-powered multiengine airplanes), to a new § 91.22 so that this requirement would apply to all airplanes. Additionally, fuel requirements would be added for night VFR flight and rotorcraft operations.

Although a number of commenters supported the proposed amendment, a larger number disagreed. Some of those who disagreed stated that the proposed amendment was an attempt to legislate safety in an area which has been governed by common sense. Judging from the increasing number of fuel exhaustion accidents which occur each year, the FAA believes there must be a more precise means to determine an adequate fuel reserve for VFR flight.

A few commenters stated that the fuel requirements are already contained in § 91.5 and that proposed § 91.22 was, therefore, redundant. Section 91.5 requires the pilot to be informed regarding "fuel requirements". It does not, however, contain a requirement for fuel reserves beyond the first point of intended landing.

Three commenters favored simplification of the regulation by making the fuel reserves the same for both day and night. One of the commenters favored one hour and two favored 30 minutes for both. The FAA believes that the distance between adequately lighted airports warrants the additional fuel reserves for night VFR operation.

One commenter recommended that § 91.22 be made consistent with § 91.23 by using the term "civil aircraft" instead of "airplane" in § 91.22. The FAA agrees and the term "civil aircraft" is used in the title to § 91.22.

One commenter suggested that the phrase "normal cruising speed" be used rather than "normal cruising fuel consumption" to make the nomenclature the same as in § 91.23(c). The FAA agrees, and § 91.22, as adopted, is revised accordingly.

Proposal 6–9. The purpose of proposed § 91.23 was to simplify flight planning by eliminating the reference to minimum obstruction clearance altitude (MOCA) and minimum en route IFR altitude (MEA). A number of commenters said that the proposed revision was somewhat simpler than the current rule but that it was still cumbersome. They suggested that it would be much simpler if criteria were established which would require the pilot to determine only that a certain ceiling and visibility would exist one hour before and one hour after the estimated time of arrival at the airport of first intended landing. Most commenters supported a ceiling of 2,000 feet above the airport elevation and three miles visibility. However, a number of commenters recommended ceilings of 2,500 and 3,000 feet and one commenter suggested a visibility of four miles. After further review, the FAA believes that, in the interest of simplicity, this proposal should be modified to require only a ceiling of 2,000 feet above the airport elevation and three miles visibility for the period one hour before and one hour after the estimated time of arrival at the first airport of intended landing.

Another commenter stated that the proposed rule would do little or nothing for safety and would be almost immpossible to enforce. The FAA does not agree. The FAA believes that the amendment was designed to provide a simpler and less restrictive means for determining fuel requirements and that the amendment is enforceable.

Additionally, § 91.83(b) is amended to make the information required for a flight plan consistent with the ceiling and visibility requirements of § 91.23 as adopted. See Proposal 6-16.

One commenter suggested that the word "applicable", as used in § 91.23(b)(2)(ii), should be explained. Since § 91.23, as adopted, deletes the reference "applicable visibility minimums", this no longer presents a problem. Section 91.23, as adopted, is revised accordingly.

Proposal 6-10. Current § 91.25(a)(2) requires an operational check of the VOR within the preceding ten hours of flight time and within ten days before flight. Proposed § 91.25(a)(2) and (d) would delete the ten day requirement and predicate the VOR equipment check requirement on ten hours of flight time. Numerous commenters pointed out that it would be inconsistent to refer to flight time in § 91.25(a)(2) and to refer, in § 91.25(d), to "tachometer time" and "aircraft time". A number of commenters suggested that only days be used as the guide and a period of 30 days to 90 days would be feasible considering the improved reliability of VOR equipment and the need to reduce the aircraft operator's recordkeeping burden. The FAA agrees. Accordingly, proposed § 91.25(a)(2) is revised to require that the VOR equipment be checked at least every 30 days rather than after ten hours of flight time. Since § 91.25(a)(2), as adopted, no longer contains a reference to flight time, there is no longer a need to amend § 91.25(d) to require tachometer time, or, in its absence, aircraft time to date. Accordingly, these references are deleted. The FAA believes, after further consideration, that there would be no useful purpose in retaining a permanent record of the VOR equipment check. Therefore, the word "permanent" is deleted in both places where it appears in § 91.25(d), as adopted.

Proposal 6-11. Proposed § 91.29 would require the pilot in command of a civil aircraft to enter in the aircraft log and maintenance record of the aircraft any mechanical discrepancy noted during flight. The majority of commenters opposed the proposed amendment. They stated that the log and maintenance records are permanent records which should not be cluttered with discrepancies noted by the pilot, the term discrepancy is not defined and, as worded, the proposed amendment stipulates that the discrepancy must be entered in both the aircraft log and maintenance record. They also stated that the proposed rule is unenforceable, the proposed amendment would require the pilot/owners to write a note to themselves and persons operating under Part 121, 123, 127 and 135 have established procedures for reporting mechanical irregulatities.

After further review and careful consideration of all the comments, the FAA believes that the current regulations are adequate and proposed § 91.29 is withdrawn.

Proposal 6-12. This proposal would amend § 91.33(b)(12 to require safety belts to have metal latching devices. See the discussion for Proposal 6-1. One commenter called our attention to the fact that current § 91.33(b)(12) states ". . . approved seat belts for all occupants . . ." whereas the proposed amendment states ". . . for each occupant . : .". Since it was not our intention to make this change the proposal has been amended to use the wording of the current rule.

Proposal 6-13. This proposal would mean § 91.36(b) to require that the equipment be tested to the maximum operating altitude of the aircraft. Almost all of the comments received were favorable. One commenter asked what is meant by maximum operating altitude and stated that a definition is needed somewhere. The definition is contained in §§ 23.1527, 25.1527, 27.1527 and 29.1527 which describe maximum operating altitude limitations. These limitations are also contained in the aircraft flight manual. The proposed amendment is adopted without change.

Proposal 6-14. Proposed § 91.45(a)(3)(ii) would allow a takeoff on a wet runway with one engine inoperative based solely on engineering findings. Several commenters objected to this proposal, contending that the initial approval must be based upon demonstration under actual conditions. Other commenters stated that one engine inoperative takeoffs from a wet runway should not be allowed on the basis of analytical data alone. In view of these comments and after further review, this proposal is withdrawn.

Proposal 6-15. Proposed § 91.54(a)(2) would require a typed or printed name and address and the signature of the person responsible for operational control of large aircraft. Two comments concurred with the proposal as written.

One commenter stated it was not necessary for the government to regulate the manner in which a form is completed. The commenter further stated that if the form is not completed in a manner acceptable to the FAA, it should be refused. The FAA believes that it should regulate the manner in which the form is completed and that the person making out the form should know in advance what is acceptable to the FAA. Accordingly proposed § 91.5(a)(2) is adopted without substantive change.

Proposal 6-16. Proposed § 91.83(b) as adopted, makes the information required for a flight plan consistent with the ceiling and visibility requirements of amended § 91.23. See the discussion for Proposal 6-9.

Proposal 6-17. The proposed change to § 91.193 would require a hand fire extinguisher in the passenger compartment of each airplane accommodating less than 31 passengers.

The commenters who opposed the rule change stated that the fire extinguisher would add unnecessary weight to the aircraft, would discharge all over the cabin when used, and would create a hazard if it became loose during turbulence. One commenter said that small airplanes which carry up to six passengers usually operate at lower altitudes and can, therefore, be landed readily if an in-flight fire starts.

Another commenter had never heard of an in-flight fire except an engine fire, and that a fire extinguisher in the cabin would be of no help in such a situation. In view of the comments and after review, this proposal is withdrawn.

Proposal 6-18. Proposed § 91.201(b) would require a sideward restraint for under seat baggage. Commenters who opposed the proposed amendment cited the installation costs, extra weight, and out-of-service time for installation of such restraining devices. The FAA believes the costs and added weight would be minimal and justified considering the improved safety provided. After further review, the FAA believes that the operator should be given additional time to install these restraint devices. Accordingly, this amendment provides a compliance date of one year from the effective date of this amendment. Since the operator has been given one year to make these installations, there should be little or no disruption of flight operations. Commenters also contended that since, in an emergency, most of the forces are forward, there is little tendency for the baggage to move sideward, and, in emergency evacuation demonstrations conducted by the airlines, items of mass placed in the aisle were found to create no delay. The FAA believes that these commenters limited their observations to crash landings where the motion would be forward. Severe turbulence may also create a potential hazard to passengers when large articles become dislodged. The FAA cannot agree that, in emergency evacuation demonstrations, items of mass cause no delay. They cause delay when placed in the aisles during evacuation tests to simulate actual conditions caused by unrestrained under seat items moving into the aisles during a crash landing. Several commenters in favor of the proposal stated that they had observed under seat baggage that moved sideward blocking the aisles during heavy turbulence or emergencies.

Accordingly, § 91.201(b) is adopted as proposed with the delayed compliance date as noted.

Proposal 6-19. The proposed deletion of § 91.207 is related to the proposal for a new § 91.22 (See the discussion for Proposal 6-8) which would make the requirement for fuel reserves of 30 minutes for day VFR and 45 minutes for night VFR applicable to all airplanes operated under Part 91. No commenters objected to the deletion of current § 91.207 if new § 91.22 is adopted. Since § 91.22 is adopted, § 91.207 is deleted.

Proposal 6-20. No opposing comments were received concerning proposed § 91.213(c). Accordingly, § 91.213(c) is adopted as proposed.

AMENDMENT TO § 121.417

Amendment No. 121-144 (43 FR 22643; May 25, 1978) amended the crewmember emergency training provisions of § 121.417 by requiring each crewmember to actually operate each item of equipment required for the deployment and use of emergency evacuation slides. However, as stated in Notice No. 77-12 (42 FR 37417), while flight attendants would be required to operate the associated escape devices during initial and recurrent training, automatic and manual escape chutes need not be deployed each time that the associated exit is cycled.

However, since publication of Amendment No. 121-144, it has come to the attention of the FAA that this amendment could be given an overly restrictive interpretation and that further clarification is necessary. Accordingly, this amendment revises § 121.417(c) to make it clear that the emergency drill requirements prescribed for crewmembers apply to both initial and recurrent training. Also, it more clearly specifies that each crewmember is not required to actually operate (removal, transfer or inflation of the life raft, or slide/raft pack) the equipment specified in paragraphs (c)(6)(v), (c)(6)(vi), and (c)(6)(vii) during emergency drills. Additionally, this amendment clarifies the fact that the evacuation slide need be used only once during each training phase.

Finally, the phrase "or training device" has been inserted in §§ 121.417(c)(6)(v) and (vii) respectively to clarify the fact that the training specified may be conducted in a training device.

Since this amendment is relaxatory and clarifying in nature and does not impose a burden on the public, I find that notice and public procedure are unnecessary and this amendment may be made effective without notice.

AMENDMENT TO § 121.437

Amendment No. 121-144 (43 FR 22643; May 25, 1978) amended § 121.437(b) to require pilots to hold a category and class ratings appropriate for the type of aircraft being used. After the amendment to § 121.437(b) became effective, the FAA was informed by the Air Transportation Association (ATA) that the amendment would be extremely costly and very difficult for the airlines to comply within the specified time, as it would require the airlines to provide aircraft flight checks for more than 5,000 pilots to obtain the required category and class ratings. Consequently, the effective date of § 121.437(b) was extended to July 1, 1980, by Amendment No. 121-146 (43 FR 28403; June 29, 1978).

In addition, ATA stated the training provided to pilots, other than pilots in command, under the provisions of Part 121 and the proficiency checks requirements of § 121.441 are equivalent to the standards required for a commercial pilot to obtain an airplane category and class rating.

Accordingly, § 121.437(b) is amended to allow pilots who are currently employed by a certificate holder and have satisfactorily completed the approved training program under Subpart O, including the proficiency flight check required by § 121.441, of this Part, to be issued the appropriate category and class rating by presenting proof of compliance with those requirements to an Air Carrier or Flight Standards District Office. The FAA believes that this amendment would provide an equivalent level of safety.

To delay this amendment would pose an undue burden to the certificate holders and pilots affected by the amendment. For this reason, the FAA has determined notice and public procedure hereon are impractical and contrary to the public interest.

AMENDMENT TO § 121.439

Amendment No. 121-144 (43 FR 22643; May 25, 1978) amended § 121.439(c)(2) to require pilots to be currently qualified in another airplane of the same group prior to that pilot receiving recency of experience training in a visual simulator.

After further review, the FAA believes that this requirement is too restrictive in that it would not allow certificate holders that operate only one type of airplane in the same group to allow their pilots to use a visual simulator to reestablish recency of experience requirements, as it would be impossible for their pilots to be dual qualified, or currently qualified in another airplane of the same group. This amendment deletes § 121.439(c)(2) and allows use of the visual simulator to reestablish recency of experience requirements. As these changes are relaxatory and clarifying in nature and do not impose a burden on the public, notice and public procedure are unnecessary and these changes are adopted as noted.

ADOPTION OF THE AMENDMENTS

Accordingly, Parts 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, 91, and 121 are amended effective December 4, 1978, except for Section 121.417 which is effective September 29, 1978.

Sections 313, 314, and 601 through 610 of the Federal Aviation Act of 1958 (49 U.S.C. 1354, 1355, and 1421 through 1430) and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25-45

Fatigue Regulatory Review Program Amendments

Adopted: September 28, 1978 Effective: December 1, 1978

(Published in 43 FR 46238, October 5, 1978)

SUMMARY: The purpose of these amendments is to improve and update the airworthiness standards applicable to the type certification of transport category airplanes by revising the structural fatigue evaluation requirements. These revisions take into account state-of-the-art developments and accumulated service experience.

FOR FURTHER INFORMATION CONTACT: Adolfo O. Astorga, Airworthiness Review Branch (AFS-910), Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue S.W., Washington, D.C. 20591; telephone: 202-755-8714.

SUPPLEMENTARY INFORMATION: During the recent years, there have been significant state-of-the-art and industry-practice developments in the area of structural fatigue and fail-safe-strength evaluation of transport category airplanes. Recognizing that these developments could warrant some revision of existing fatigue requirements contained in §§ 25.571 and 25.573 of Part 25 of the Federal Aviation Regulations, the FAA, on November 18, 1976, gave notice of its Transport Category Airplane Fatigue Regulatory Review Program and invited interested persons to submit proposals to amend those requirements (see 41 FR 50956). Subsequently, the FAA convened a Transport Category Airplane Fatigue Regulatory Review Conference during March 15-17, 1977, in Arlington, Virginia, to obtain the views of all concerned on the proposals submitted for the review.

Participants in the Review Conference discussed the proposals submitted for the review. Those proposals and the related discussions formed the basis for the FAA's belief that a comprehensive revision of the structural fatigue evaluation standards of §§ 25.571 and 25.573 was warranted. To that end, on August 9, 1977, the FAA issued Notice 77-15 (42 FR 41236; August 15, 1977) which proposed regulatory changes directed at upgrading and improving those standards. These amendments are based on that Notice.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. The more significant comments received in response to Notice 77-15 are discussed below. A number of substantive, editorial, and clarifying changes have been made to the proposed rules based on relevant comments received and on further review within the FAA. Except for minor editorial and clarifying changes and the changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notice 77-15.

DISCUSSION OF GENERAL COMMENTS

Sixteen comments were received in response to Notice 77-15. Several of the commenters were associations that presented the views of manufacturers and air carriers. In general the commenters concerned themselves with those areas of the proposal they believed could be improved and they raised no objection to the basic concept of the proposal.

Two commenters recommended that full-scale fatigue tests of the whole airplane structure be required, so as to ensure reliable identification of those locations and detail design points at which a fatigue failure, if not detected in time, could cause catastrophic failure of the airplane. The FAA disagrees. Although full-scale testing can be useful in predicting possible locations of fatigue failures, the test results do not always correlate with service experience because of differences in the loading spectrum, varying environmental conditions, scatter in the test data, and unpredictable operational effects. Under the rules being adopted the manufacturer is required to:

(1) determine the probable locations and modes of damage due to fatigue, corrosion, and accidental damage, (2) support that determination by tests on either the whole structure or components of the structure and by reference (as applicable) to previous operational experience; and (3) establish a related inspection program. This practice has been used successfully in the past.

A commenter recommended that the applicant be required to determine the "time to first failure" of critical structural components, and to establish information on the frequency, extent, and methods of inspection, by repeating the fatigue test program on an appropriate number of identical samples of those components and by employing probabilistic evaluation and risk analysis. The FAA recognizes that this procedure may be necessary for some critical safe-life components but not for those evaluated by means of the damage-tolerance approach covered in this amendment. Damage-tolerance (fail-safe) evaluations take into account the possibility that structural damage can occur due to causes other than classical fatigue (for example: corrosion, foreign-object impact, and maintenance errors) and recognizes that this damage can be detected before catastrophic failure by an adequate inspection procedure. The frequency, extent, and methods of inspection are determined by repeated load analyses and tests (including a statistical approach where necessary), by fracture mechanics analyses and tests, and by reference to service experience.

The same commenter, referring to damage-tolerance evaluation tests, suggested that such tests should be carried out to final failure to demonstrate the residual strength of the remaining structure and that the loading conditions for this purpose should take into account the effects of structural flexibility, the rate of loading, and the most unfavorable expected temperature in heavy gusts. This commenter also contended that simulation of cracks artificially should not be allowed since this method would predetermine the location of failure and would in many cases indicate a greater residual strength than a genuine fatigue crack. The FAA does not agree with these comments. The nature and extent of tests on complete structure, or on portions of the primary structure, will depend upon applicable previous design, construction, tests, and service experience. If previous experience with similar structure is available, an analytical approach rather than tests may be sufficient to show adequate residual strength. The applicant is required in either event to take into account the factors mentioned by the commenter. For example, § 25.571(a)(1)(i) of this amendment requires that each evaluation include the "typical loading spectra, temperatures, and humidities expected in service." And § 25.571(b) of this amendment requires that "if significant changes in structural stiffness or geometry, or both, follow from a structural failure, the effect on damage-tolerance must be further investigated." Concerning the matter of simulating cracks artificially, the FAA has found from past experience that it may not be practical to produce actual fatigue cracks. Artificial crack simulation has proven satisfactory in the past.

In addition, the commenter, referring to the proposed requirements for damage-tolerance (fail-safe) evaluation, contended that the pilot should be instantaneously warned of the occurrence of a failure of a single principal structural element, because no hidden strength reserves are required. The FAA questions whether the crack detection and monitoring system that would be needed for this purpose could be relied upon to detect all critical damage. In any event, the FAA believes such a warning system is unnecessary, for the following reasons. This amendment specifies a residual static strength level of 100 percent of limit load (up from the previously prescribed 80 percent) and requires residual repeated load strength consistent with crack growth analysis and with the anticipated inspection program, thereby raising the level of safety for structure in a "damaged" condition. Structure designed to these requirements remains capable of supporting static limit loads after partial failure until the failure is detected, since those loads are the maximum loads expected to occur in service. In addition, to account for the fatigue spectrum, the damage-tolerance evaluation must incorporate repeated load and static analyses supported by test evidence. On the basis of past experience, the FAA believes that these requirements provide an adequate level of safety when combined with a sound inspection program that ensures detection of damage before catastrophic failure occurs.

Several commenters objected to the use of mandatory language in proposed Appendix H contending that it was inconsistent with statements in the notice preamble, and in proposed § H25.1 of the Appendix, that the Appendix contained guidance material and that deviations from this guidance material may be necessary to take into account new design features and methods of fabrication, new evaluation approaches, and new configurations. The FAA agrees in principle with these comments. However, with the removal of the mandatory language objected to by the commenters, the proposed Appendix would not be regulatory in nature. Placement in the Federal Aviation Regulations would therefore not be appropriate. In this connection, the FAA's Advisory Circular system is an effective vehicle for providing guidance information to the public relating to regulatory matters. Accordingly, proposed Appendix H, with mandatory language removed and with additional changes as discussed below, is being issued concurrently with this amendment in the form of a new Advisory Circular. A reference to the new Advisory Circular is included in § 25.571(a), as adopted, and copies of the Advisory Circular may be obtained from—U.S. Department of Transportation, Publications Section M-443.1, Washington, D.C. 20590.

DISCUSSION OF SPECIFIC COMMENTS

§ 25.571(a)

Several commenters objected to the wording of the first sentence of proposed § 25.571(a), contending that it would impose an absolute requirement that would be impossible to comply with. The purpose of the proposal was to establish an evaluation requirement rather than an absolute requirement for the strength, detail design, and fabrication of the airframe structure. Based on the comments, the first and second sentences of proposed § 25.571(a), as adopted, are revised to make this clear.

A commenter suggested that the term "engine mounting" be added to the examples of structure listed (in parentheses) in the second sentence of proposed § 25.571(a) since it is an important structural element that should be considered. The FAA agrees, and this change is incorporated in the adopted rule. In addition, the word "including" inside the parentheses is changed to "such as" to make it clearer that the structural elements listed are examples only.

A commenter objected to the sonic fatigue evaluation requirement in the third sentence of proposed § 25.571(a), contending that while such an evaluation is necessary for turbojet-powered airplanes there has been no service experience indicating that it is also necessary for turbopropeller powered airplanes. The FAA agrees. Based on a reevaluation of the information available to the FAA, the term "turbine-engine-powered" in the third sentence of proposed § 25.571 (fourth sentence as adopted) is changed to "turbojet-powered".

Several commenters objected to proposed § 25.571(a)(3) on the grounds that—(1) the required inspection or other procedures to prevent catastrophic failure are best developed after type certification by the combined efforts of the FAA, the manufacturers, and the operators, using the Maintenance Review Board (MRB) process described in Advisory Circular AC 121-22; and (2) if the inspection and other procedures were to be established as a certification requirement, operators would find it burdensome to have them adjusted in the light of operational experience after an airplane enters service. The FAA firmly believes that in this critical safety area (involving measures to prevent catastrophic failure) the initial set of inspection and other procedures must be established by the manufacturer under a type certification requirement. Since the manufacturer conducts the evaluation tests and analyses upon which those procedures must be based, it is appropriate that he take prime responsibility for establishing them. However, there is nothing in proposed § 25.571(a)(3) that would prevent later adjustments of the established inspection, or other procedures, based on operational experience after type certification. See also the related discussion under proposed Appendix § H25.2(h). Accordingly, proposed § 25.571(a)(3) is adopted without change.

§ 25.571(b)

A commenter noted that the parenthetical term "(fail-safe)" in the title of proposed § 25.571(b) is not a synonym for "damage-tolerance." The FAA used the term "(fail-safe)" in the title merely to indicate that this was the previously accepted evaluation method. Some fail-safe design features may still be incorporated in a damage-tolerance approach. The term "(fail-safe)" is therefore retained in the title.

The same commenter recommended that the phrase "test evidence and service experience" in the second sentence of proposed § 25.571(b) be changed to "test evidence *or* service experience," contending that the proposed language would prevent designers from doing anything new. The FAA's intent is to require that the analysis be supported by test evidence in every instance and (if available) by service experience. To make this intent clear, the parenthetical phrase "(if available)" is inserted before the term "service experience" in the adopted rule.

The commenter also objected to the third sentence of proposed § 25.571(b) on the ground that it limits the concern to prior fatigue exposure only. No change to the proposal is being made based on this comment since the FAA believes the proposed language adequately reflects the intent.

In addition, the commenter contended that the fourth and fifth sentences of proposed § 25.571(b) were not sufficiently specific and suggested a general revision of the proposed language. The FAA does not agree. The FAA believes that the proposed language is clear and expresses the intent accurately.

Another commenter suggested that the words "at V_c" in proposed § 25.571(b)(1) be changed to "up to V_c", contending that maneuvers at speeds lower than V_c should also be covered. The FAA believes that the words "at V_c" provide for a realistic and adequate condition for residual strength evaluation that is consistent with a similar loading condition applied under the rule being amended.

This commenter also suggested that proposed § 25.571(b)(2) be revised to ensure that dynamic effects are covered for gust conditions. The FAA believes that the gust conditions in proposed § 25.571(b)(2), which are similar to those applied under the rule being amended, are adequate for residual strength evaluations.

In addition, the commenter noted that § 25.351(a), which is referenced in proposed § 25.571(b)(4), does not specify yaw maneuvers at speeds above V_A and suggested a revision to specify such maneuvers. The FAA, in Airworthiness Review Notice No. 75–26 (40 FR 24802; June 10, 1975) has proposed changing the V_A in current § 25.351(a) to V_D. This issue will be considered as part of the Airworthiness Review Program.

A commenter suggested that the term "normal operating pressure" used in proposed §§ 25.571(b)(5)(i) and (ii) be changed to "normal operating differential pressure" because it is more precise and is used elsewhere in Part 25. The FAA agrees, and this change is incorporated in §§ 25.571(b)(5)(i) and (ii) as adopted.

A commenter recommended that the 1.1 factor in proposed § 25.571(b)(5)(ii) be changed to 1.15 to be consistent with existing design practice based on the present Federal Aviation Regulations, and to cover variations in strength due to material properties and undetected corrosion. The FAA disagrees. The only purpose of the 1.1 factor is to take into account pressure relief valve tolerances. Material variations are covered elsewhere in the regulations. The FAA does not believe an increase to 1.15 is justifiable.

Two commenters suggested revisions to the flush paragraph at the end of proposed § 25.571(b) to make clear which effects are to be considered. The FAA believes that the proposed language adequately covers the range of effects to be considered.

§ 25.571(c)

Several commenters noted the typographical error in the title of proposed §25.571(c). The parenthetical term "(safe-fail)" should be "(safe-life)." This error is corrected in the final rule.

A commenter objected to proposed § 25.571(c) on the ground that it would give the FAA new powers to overrule the manufacturer's judgment as to whether it would be impractical, for a given structure, to comply with the damage-tolerance requirements of proposed § 25.571(b). Under the rules being amended, the commenter noted, the manufacturer has the option of selecting either the "safe-life" or "fail-safe" approach. The FAA has considered this comment; however, service experience has shown conclusively that the damage-tolerance (fail-safe) approach is more reliable than the safe-life approach, particularly since the safe-life approach does not take into account the probability of damage due to foreign-object impact, corrosion, or improper maintenance. The FAA firmly believes that safety is best served by requiring the manufacturer to use the damage-tolerance approach unless he shows to the FAA's satisfaction that it would be impractical to do so.

Several commenters pointed out that the third sentence of proposed § 25.571(c) would improperly allow cracking to occur. The FAA agrees. As noted by the commenters, the intent of the proposal was to require that the structure be able to withstand the repeated loads of variable magnitude expected during its service life without detectable cracks. Accordingly, in the adopted rule, the third sentence of proposed § 25.571(c) is deleted, and the words "without detectable cracks" are added to its second sentence for clarification. One of these commenters suggested that the last sentence of proposed § 25. 571(c) also be deleted since it is covered in the proposed Appendix. The FAA believes that this sentence is necessary in the basic rule as well as in associated guidance material.

A commenter contended that proposed § 25.571(c) omitted a key requirement—that no reduction in strength be allowed. The FAA disagrees. Experience with transport airplane structure and materials has shown that there is no significant reduction in ultimate strength due to repeated load application unless detectable cracks have developed. Therefore, if it is shown that no detectable cracks will be initiated during the service life of the structure, the FAA considers that no reduction in ultimate strength will occur.

§ 25.571(d)

No adverse comments were received concerning proposed § 25.571(d). Accordingly, § 25.571(d) is adopted as proposed.

§ 25.571(e)

A commenter objected to proposed § 25.571(e), contending that it would be impossible to obtain a type certificate for propeller-driven airplane under its provisions. This commenter stated that it is difficult to imagine designing airplanes strong enough to withstand a two to three hundred pound propeller, or even a single propeller blade, coming loose and crashing through the fuselage. The FAA believes that a transport category airplane making use of structural design features such as slow crack growth, crack arrestment, and multiple load path construction, can be designed for discrete source damage, including propeller impact damage. This would require that the structure withstand the static loads expected during completion of the flight (on which the impact damage occurred). The extent of the damage would be determined on the basis of a rational assessment of operational experience and potential damage. The FAA has no reason to believe that designers of propeller-driven airplanes would not be able to comply with proposed § 25.571(e), as adopted.

Another commenter expressed concern lest interpretation of proposed § 25.571(e), insofar as it would apply to structural damage caused by propeller blade impact, might discourage the development of new advanced turoprop airplanes and, therefore, would not be in the public interest. The FAA anticipates no interpretation problem in administering § 25.571(e), as adopted, and has no reason to believe that designers of turoprop airplanes would not be able to comply with its provisions.

A commenter recommended that proposed § 25.571(e) be deleted on the ground that each of the items listed in subparagraphs (1) through (4) necessitates special consideration of the circumstances under which the event arises and that they therefore warrant separate traeatment in the regulations, as is done currently in Part 25. Moreover, this commenter contended, no detailed justification has been provided for proposed § 25.571(e), which in general represents an increase in severity over current regulations. The FAA believes that it is appropriate to consider the items in subparagraphs (1) through (4) together since the concern in each instance is the probability of structural damage. The need for these requirements is dictated by service experience. Modern damage-tolerance (fail-safe) techniques, such as slow crack growth, crack arrestment, and multiple load path construction, make it possible to provide a capability of surviving discrete source damage.

A commenter suggested that proposed § 25.571(e) be transferred to Subpart D of Part 25 since it covers more than structural implications. The FAA disagrees. The intent is to cover only the structural implications of the listed impacts and failures, as the proposed language makes clear. The FAA is concerned here only with structural damage.

A commenter considered that the word "likely" in the lead-in of proposed § 25.571(e) was not necessary. The FAA disagrees. The word "likely" has a substantive probability connotation in this context.

Two commenters noted that the bird strike condition in proposed §25.571(e)(1) is different from those in current §§ 25.631 and 25.775, and commenter suggested they be made consistent. The FAA believes there may be merit in this suggestion but does not have sufficient information, at this time, on which to base any revision of current §§ 25.631 and 25.775. The FAA believes, however, that proposed § 25.571(e)(1) is a realistic condition for structural damage assessment in general.

A commenter suggested that the sources of structural damage listed in proposed § 25.571(e) include "faulty maintenance" and "faulty operation." The FAA disagrees. Likely sources of this kind are considered during damage-tolerance (fail-safe) evaluation.

A commenter suggested that the word "static" in the first sentence of the flush paragraph at the end of proposed § 25.571(e) is unnecessary and should be deleted. The FAA disagrees, since the word "static" is necessary to describe the internal ultimate design loads expected to occur.

Several commenters objected to the third sentence of the flush paragraph at the end of proposed § 25.571(e), contending that dynamic effects are adequately taken into account when determining the likely structural damage caused by the listed discrete-source impacts and failures and the magnitude of the static loads that would subsequently occur in flight. The FAA agrees, and the flush paragraph in the adopted rule is revised to make this point clear.

Two commenters suggested revisions to the last sentence of the flush paragraph at the end of proposed § 25.571(e) to make clear which effects are to be considered. The FAA believes the proposed language adequately covers the range of effects to be considered.

§ 25.573

There were no adverse comments on the proposal to delete § 25.573. Accordingly, § 25.573 is deleted.

§ 25.629(d)(4)(v)

A commenter, noting that the proposed amendment to §25.629(d)(4)(v) referred only to proposed § 25.571(b), suggested that it also refer to proposed § 25.571(e), which could have an effect not only on flutter but also on handling characteristics. The FAA disagrees. The intent of proposed § 25.571(e) is to ensure that the airplane, after receiving discrete-source damage, has sufficient residual static strength capability to successfully complete the flight. Evaluating flutter and handling characteristics goes beyond that intent.

APPENDIX H

As discussed previously, proposed Appendix H is being adopted in the form of a new Advisory Circular. In addition to removing the inappropriate mandatory language proposed in the Appendix, a number of changes have been incorporated based on the comments received and further review. Those comments and changes are discussed below.

APPENDIX H, § H25.1

A commenter suggested that the first sentence of the second lead-in paragraph of proposed § H25.1 be revised to allow the consideration of "good design practice" in determining whether an effective damage-tolerant structure can be achieved. The FAA agrees and the suggested change is incorporated in the new Advisory Circular.

A commenter suggested that "engine mounts" be added to the examples given in the last sentence of the second lead-in paragraph of proposed § H25.1 since it is not only in the attachments of these structures that difficulties may be experienced in achieving damage-tolerant designs. The FAA agrees, and this change is incorporated in the new Advisory Circular.

A commenter objected to the phrase "at critical regions in" as used in the first sentence of proposed § H25.1(c) because if stresses are of low order, the regions could hardly be called "critical." The FAA agrees, and in the new Advisory Circular the phrase "in specific regions of" is substituted for "at critical regions in".

A commenter objected to the reference to "probability" in the first sentence of proposed § H25.1(c), contending that it has an unfavorable connotation. The FAA disagrees. The use of probability terminology is appropriate in this context. However, the language in this sentence is editorially revised in the new Advisory Circular without substantive change.

A commenter noted that the words "tensile area" (modifying "cutouts") in the second sentence of proposed § H25.1(c) tend to restrict attention inappropriately since cutouts in shear and compression areas also warrant attention. The FAA agrees, and the words "tensile area" deleted in the new Advisory Circular.

Two commenters contended that it was not always possible to complete the repeated load tests necessary to show compliance with the damage-tolerance evaluation requirements in proposed § 25.571(b) within a reasonable time. This would lead, it was asserted, to a burdensome and costly delay in obtaining type certificates for airplanes. One of these commenters suggested that proposed § H25.1(c) be revised so that an applicant con obtain the type certificate without having completed those tests if the applicant substantiates at least one year of safe operation. The other commenter suggested that a somewhat similar provision be added to proposed § H25.2(g). The FAA believes that the circumstances described by these commenters will occur only rarely and that the need for the suggested relief (and the proper extent of that relief) can only be judged on the merits of each individual case. For these reasons, the FAA believes that it would be inappropriate to incorporate the revision suggested. Instead, the FAA will consider requests for relief on an individual basis.

APPENDIX H, §§ H25.2(a), (b) AND (c)

A commenter asserted that proposed §§ H25.2(a)(1), (2), and (3) were essentially variations of the same proposal and should be combined in a single general statement. The FAA agrees, and proposed §§ H25.2(a)(1), (2), and (3) are revised accordingly and appear in a combined form in the new Advisory Circular.

A commenter stated that, in the lead-in- sentence of proposed § H25.2(a)(6), the phrase "due to fatigue" rules out concern for corrosion damage, and the phrase "high life conditions" is not a useful concept. This commenter suggested that the lead-in be revised to read: "Provision to limit the probability of concurrent multiple damage, particularly after long service, which could conceivably contribute to a common fracture path. Examples of such multiple damage area:." The FAA agrees and proposed § H25.2(a)(6), as contained in the new Advisory Circular, incorporates this change.

A commenter objected to proposed § H25.2(a)(6)(i), contending that the word "initial" implies the cracks were present when the structure was built, and that the phrase "each of which being less than the minimum detectable length" was unnecessarily restrictive, since cracks that small are not likely to cause major concern. The commenter suggested that proposed §H25.2(a)(6)(i) be revised to read "A number of small cracks which might coalesce to form a single long crack." The FAA believes the suggested language clarifies the intent. The new Advisory Circular incorporates this language.

The same commenter objected to proposed § H25.2(a)(6)(ii), contending that the word "initial" here implies the failure was built in and that the phrases "following an initial failure" and "due to redistribution of loading" should be in reverse order to avoid confusion. The commenter suggested that proposed § H25.2(a)(6)(ii) be revised to read: "Failures, or partial failures, in adjacent areas due to the redistribution of loading following a failure of a single element." The FAA agrees, and this language is used in the new Advisory Circular.

This commenter also objected to proposed § H25.2(c), contending that it deals with several reasonably simple concepts in a complex, obscure way. A specific revision was suggested. The FAA believes that the intent of this paragraph is clear as proposed.

APPENDIX H, §§ 25.2(d), (e), AND (f)

A commenter suggested that the last sentence of proposed § H25.2(d) be placed at the beginning of the pragraph and revised (to emphasize the preference for damage-tolerance evaluation) to read: "Every reasonable effort should be made to ensure inspectability of all structural parts, and to qualify them under the damage-tolerance provisions." The FAA agrees, and the suggestion has been followed in the new Advisory Circular. This change also responds to another commenter who suggested several changes to proposed § H25.2(d) which were aimed at emphasizing the preferability of avoiding completely uninspectable areas.

A commenter noted that in proposed § H25.2(e) the words "damage" and "failure," which were apparently intended to be synonymous, convey separate concepts. The FAA agrees, and in the new Advisory Circular the sentence is clarified.

APPENDIX H, §§ H25.2(g) AND (h)

A commenter recommended a general revision of the lead-in paragraph of proposed § H25.2(g), contending that: (1) the phrase "damage extent for residual strength" should convey a different idea than it does in proposed § H25.2(c); (2) the phrase "the time at which the damage becomes initially detectable" is not quite accurate since "initially detectable" implies a much smaller dimension than is likely to be appropriate; and (3) the second sentence appears to be a rather academic requirement. The FAA disagrees. The intent of proposed § H25.2(g) is to identify damage-tolerance criteria (analytical and test) with respect to residual strength, damage growth rate, inspection programs, repeated loads, damage-tolerance characteristics, and discrete source damage. The FAA believes this intent is clear in the language proposed. However, based in part on a comment concerning proposed §§ H25.2(g)(1), (2), and (3), the FAA believes that proposed § H25.2(g)(2) would be clearer if it read: "By demonstrating that the damage would be detected before it reaches the value for residual strength evaluation." In addition, based on a review of proposed § H25.2(g)(3), the FAA believes that the previously verified design should also have a similar configuration. These changes are incorporated in the new Advisory Circular.

Two commenters suggested a revision to make it clear that the applicant can use any one of the methods listed in §§ H25.2(g)(1), (2), and (3) for showing damage-tolerance characteristics. The FAA agrees, and appropriate changes are incorporated in the new Advisory Circular.

A commenter suggested that a provision be added to proposed § H25.2(g) to enable an applicant to obtain a type certificate without having completed the repeated load tests necessary to support damage-tolerance evaluation (where practical) of structure. For a discussion of this and a similar suggestion submitted by another commenter, see the preamble discussion for proposed § H25.1.

A commenter agreed with proposed § H25.2(h), but suggested that it should contain a factor on inspection intervals to allow for scatter in structural behavior, operational usage, and inspection reliability. The FAA recognizes that the inspection interval should be conservative, but believes that it would be appropriate to prescribe a specific factor. It is preferable that the factor be established by the manufacturer after all contributing parameters have been considered. Final approval would be by the FAA.

Several commenters objected to the last sentence of proposed § H25.2(h), contending that it should mention (as an example of a document that provides for revision as a result of operational experience) the operator's FAA-approved structural inspection program developed through the Maintenance Review Board (MRB) procedures for Part 121 operators. The FAA agrees, and the new Advisory Circular references the MRB-generated programs. In addition, a reference to § 25.571(a)(3) is also added.

APPENDIX H, § H25.3

A commenter objected to the reference to "probability" in the first sentence, contending that it has an unfavorable connotation. The FAA disagrees. The use of probability terminology is appropriate in this context. However, the language in this sentence is editorially revised in the new Advisory Circular, without substantive change, for consistency with similar provisions elsewhere.

A commenter suggested that the words "consideration of" in the third sentence of proposed § H25.3(a) should be deleted. With the elimination of the mandatory language from the proposed Appendix, these words are superfluous. They do not appear in the new Advisory Circular.

Three commenters objected to the phrase "to prevent catastrophic failure" in proposed § H25.3(a)(5). The FAA believes that the intent of proposed § H25.3(a) is adequately expressed in general terms in the first sentence of proposed § H25.3(a), and that this intent need not be repeated in § H25.3(a)(5). An appropriate revision is contained in the new Advisory Circular.

A commenter, referring to proposed § H25.3(a)(5), suggested that FAA specify approved methods and procedures (for rework or repair of the structure) that might gain further life. The FAA disagrees, since this suggestion, if adopted, would tend to unnecessarily dictate design.

ADOPTION OF THE AMENDMENT

Accordingly, Part 25 of the Federal Aviation Regulations (14 CFR Part 25) is amended effective December 1, 1978.

Sections 313(a), 601, and 603 of the Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, and 1423 and section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 25–46

Airworthiness Review Program Amendment No. 7: Airframe Amendments

Adopted: October 20, 1978 **Effective: December 1, 1978**

(Published in 43 FR 50578, October 30, 1978)

SUMMARY: The purpose of these amendments to the Federal Aviation Regulations is to update and improve the airframe and crashworthiness standards applicable to the type certification of aircraft, and to make related changes to the operating rules contained in Part 121. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

Adolfo O. Astorga, Airworthiness Review Branch (AFS–910), Flight Standards Service, Federal Aviation Administration, 800 Independence Avenue SW., Washington, D.C. 20591; telephone 202–755–8714.

SUPPLEMENTARY INFORMATION: These amendments are the seventh in a series of amendments to be issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this Airworthiness Review Program:

Title—FR citation

Form number and clarifying revisions (40 FR 2576; Jan. 14, 1975).
Rotorcraft anticollision light standards (41 FR 5290; Feb. 5, 1976).
Miscellaneous amendments (41 FR 55454; Dec. 20, 1976).
Powerplant amendments (42 FR 15034; Mar. 17, 1977).
Equipment and systems amendments (42 FR 36960; July 18, 1977).
Flight amendments (43 FR 2302; Jan. 16, 1978).

The amendments now being issued are based on five Notices of Proposed Rulemaking—Notice 75–10, published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802); Notice 75–19 published in the FEDERAL REGISTER on May 19, 1975 (40 FR 21866); Notice 75–23 published in the FEDERAL REGISTER on May 27, 1975 (40 FR 23048); Notice 75–26 published in the FEDERAL REGISTER on June 10, 1975 (40 FR 24802); and Notice 75–31 published in the FEDERAL REGISTER on July 11, 1975 (40 FR 29410).

The amendments based on Notice 75–10 were deferred in the series of amendments titled "Miscellaneous Amendments" so that they could be considered with the final disposition of certain proposals in Notices 75–23, 75–26, and 75–31. The amendments based on Notice 75–19 were deferred in the series of amendments titled "Powerplant Amendments" so that they could be considered with the final disposition of certain proposals in Notice 75–31. The amendments based on Notice 75–23, including the related amendments based on Notice 75–10, were deferred in the series of amendments titled "Equipment and Systems Amendments" for further consideration and review.

The amendments based on Notice 75–31, and the related amendments based on Notices 75–10, and 75–19, implement the rotorcraft proposals or parallel proposals for the other aircraft airworthiness Parts. These proposals were brought forward for consideration with the final disposition of the proposals in Notice 75–26 in order to dispose of all the outstanding rotorcraft proposals and allow the announcement of a rotorcraft regulatory review. The discussions of the comments received for the deferred proposals from Notice 75–10 are included under the heading of the related proposals from Notices 75–23, 75–26, and 75–31. The discussions of the comments received for the deferred proposals from Notice 75–19 are included under the heading of the related proposals from Notice 75–31.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those contained in Notices 75–10, 75–19, 75–23, 75–26, and 75–31.

DISCUSSION OF COMMENTS

The following discussion is keyed to like-numbered proposals contained in Notices 75-23, 75-26, and 75-31, and is presented in the same order as the corresponding amendments to be found in the rules portion of this document.

Proposal 7-1. One commentator recommended that the 25 feet per second head-on gust requirement in proposed § 23.345(c) be deleted because there had been no recorded failures of any flaps or flap structure attributed to head-on gusts and the proposal would increase the power-off flap loads. The FAA believes that a majority of the recorded flap and flap support structural failures resulted from head-on gusts. The amendment to § 23.345(c) is adopted without substantive change.

Based on the comments received and upon further review within the FAA, the proposal for new § 23.345(f) is withdrawn.

Proposal 7-2. One commentator objected to the proposal to amend § 23.561(b)(2) to require a 3.0g rearward ultimate inertial load for seat attachment design. The commentator stated that it is unreasonable to expect rearward inertia forces that are twice the sideward and equal to upward inertia forces. Upon further review, the FAA believes that it does not have enough information at this time to specify the minimum value to be used as a rearward ultimate inertia force. The proposal is withdrawn. However, the proposal to add a new § 23.785(h) concerning seat track retention is adopted. See Proposal 7-11.

Proposal 7-3. Several commentators objected to the proposal to amend § 23.603 and to similar proposals to amend §§ 25.603, 27.603, and 29.603. These proposals would require the applicant to show that the materials used for safety-critical parts will maintain their design properties throughout their service lives, taking into consideration the environmental considerations expected in service. The commentators stated that there is no satisfactory means of showing compliance for many materials. The limiting factors in achieving this objective were stated to be as follows: (1) A complete definition of the operating environment; (2) an understanding of interactive effects, and (3) test methods which correlate with service. After consideration of the comments received, and after further review of the materials used on modern aircraft, the FAA agrees that there may be significant difficulties in developing means to show compliance with the proposed amendments. The FAA believes, however, that the design characteristics of some materials used on aircraft may be affected by environmental conditions and that, where such materials are used in safety-critical parts, the effects of the environment upon them must be considered. The FAA further believes that the term "environmental conditions" should be clarified.

Accordingly, the proposals to add new §§ 23.603(a)(3), 25.603(c), 27.603(c), and 29.603(c) are revised to require only that the suitability and durability of materials used for safety-critical parts must take into account the effects of environmental conditions, such as temperature and humidity, expected in service.

Two commentators, while agreeing with the proposal for § 25.603, stated that the proposed requirement should apply also to fabrication methods. The FAA does not have any information at this time to indicate that the change recommended by these commentators is necessary, and the commentators did not provide any. These commentators also suggested that the term "design values" be substituted for the proposed term "design properties" to let the designer anticipate deterioration. The FAA believes that the change suggested by these commentators is unnecessary in view of the revision made in the rule as adopted.

Two commentators stated that the proposal for § 27.603(c) is not needed since the proposed requirements appear to be covered in present § 27.609. The FAA does not agree. Section 27.609 requires that each part of the structure must be protected from deterioration or loss of strength in service due to any cause, including weathering, corrosion, and abrasion, and it further requires provisions for ventilation and drainage where necessary for protection. Proposed new § 27.603(c) is concerned with the suitability of materials which may undergo changes in design characteristics, regardless of the degree of protection that is provided them.

One commentator objected to the proposal for § 27.603, stating that the subject material is adequately covered in §§ 27.613 and 27.619. The FAA does not agree. The practical effect of § 27.613 is to require that the effects of temperature on certain allowable stresses be considered where thermal effects are significant under normal operating conditions. Section 27.619 requires that special factors of safety be applied for each part of the structure whose strength is uncertain, likely to deteriorate in service before normal replacement, or subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods. The FAA believes that §§ 27.613 and 27.619 do not specifically provide for the long-term behavior of certain modern construction materials and that the proposals to amend §§ 23.603, 25.603, 27.603, and 29.603 are necessary.

Proposal 7–4. For comments concerning the subject matter of the proposal to amend § 23.605, see Proposal 7–29. The proposal is adopted without substantive change.

Proposal 7–5. No unfavorable comments were received on the proposal to amend § 23.613(c). Accordingly, the proposal is adopted without substantive change.

Proposal 7–6. One commentator objected to the wording of proposed § 23.629(a) which states, "It must be shown by any one of the methods specified in paragraphs (b), (c), or (d) of this section that the airplane is free from flutter * * *". The commentator recommended that proposed § 23.629(a) be revised to clarify that combinations of the methods in proposed §§ 23.629(b), (c), and (d) may be used to show freedom from flutter. The FAA agrees, and the proposal is revised accordingly. The commentator also recommended that proposed § 23.629(a) be revised to clarify that the flutter substantiation requirements of proposed § 23.629 are not applicable to minor structural items such as fairings, lights, and antennas which will not affect safety of flight. The FAA does not agree. The FAA believes that flutter in minor structural items can have an adverse effect upon safety of flight.

One commentator questioned who decides which of the methods specified in paragraphs (b), (c), or (d) are to be applied. The applicant can select any one of the methods specified in paragraphs (b), (c), or (d), or a combination of these methods.

One commentator objected to the requirement in proposed § 23.629(a)(1) that adequate tolerances must be established for quantities which affect flutter, including speed, damping, mass balance, and control system stiffness. The commentator stated that all quantities which affect flutter may not be significant and recommended that proposed § 23.629(a)(1) be reworded to state "those quantities or parameters that would significantly degrade the critical flutter speed are to be considered and pertinent tolerances established where necessary." The FAA believes that all quantities which affect flutter should be considered. However, the use of the word "adequate" indicates that the tolerance to be established will vary, depending on the significance of the quantity considered. Proposed § 23.629(a)(1) is adopted without substantive change.

Two commentators objected to the requirement in proposed § 23.629(a)(2) that natural frequencies of main structural components be determined by vibration tests. It was stated that this proposed change would impose a burden in the case of simple aircraft meeting the requirements of proposed § 23.629(d), and it was recommended that the words "or other approved methods" be reinstated. Upon further review, the FAA believes that the current requirement of "vibration tests or other approved methods" has provided satisfactory results in the past. Proposed § 23.629(a)(2) is revised accordingly.

The FAA believes that the intent of proposed § 23.629(b) may be unclear, since the term "stability" may be applicable either to the structural vibration modes, as intended, or to the airplane itself. The proposal is revised for clarity.

One commentator objected to the wording of proposed § 23.629(c)(1) that "proper and adequate attempts to induce flutter have been made." The commentator stated that this might be interpreted to allow pilot control impulse of the controls and this would not necessarily excite high frequency modes which may exist. The FAA believes that the wording as proposed is adequate. The proposed requirement to develop a vibratory response of the structure during the test will indicate the attempts to induce flutter, and the adequacy of the excitation can be evaluated by reference to the data record. Proposed § 23.629(c) is adopted without substantive change.

One commentator recommended the deletion of proposed § 23.629(d), which allows the use of Airframe and Engineering Report No. 45 in showing the airplane to be free from flutter but submitted no justification for the deletion. Since this report has been used for years with satisfactory results, the FAA believes that this alternative procedure, as revised and set forth in proposed § 23.629(d), should be continued.

One commentator recommended that proposed § 23.629(d)(3)(iii) be revised to state whether a trim-adjustable stabilizer would qualify as a fixed stabilizer. The FAA does not believe that any revision is necessary. The "degree of fixity" governs whether a trim-adjustable stabilizer can be considered a fixed stabilizer in regard to the use of Report No. 45. Some designs may have a high enough "degree of fixity" to allow treatment as fixed stabilizers, while others do not. Accordingly, § 23.629(d)(3)(iii) is adopted without substantive change.

One commentator objected to the proposed § 23.629(f) which would require that the airplane be free from flutter, control reversal, and divergence after the failure of any single element in the primary control system, any tab control system, or any flutter damper. The commentator stated that this requirement would add weight and cost, particularly in light single engine aircraft, since it would require that virtually all primary control systems, tab control systems, and flutter dampers be made fail-safe. The FAA believes this comment has merit, and proposed paragraph (f) is revised to require that airplanes that meet the criteria of paragraphs (d)(1) through (d)(3) of § 23.629 need to be shown to be free from flutter, control reversal, and divergence with a failure of any single element in the tab control system only. The FAA believes that the requirements of Report No. 45 satisfactorily consider the failure of any single element in the primary flight control system, and flutter dampers are not appropriate for airplanes designed to the requirements of Report No. 45. Further, tab control systems, which have been a significant cause of flutter problems, can be designed to prevent flutter after the failure of any single element by balancing or by structural fail-safe means with a minimum cost and weight increase. The FAA further believes that, for airplanes having a configuration or operating speed that does not meet the criteria of paragraphs (d)(1), (2), and (3), the requirement for considering single element failures should be applied to the primary flight control system, any tab control system, and any flutter damper. The FAA believes that for current complex, high-speed designs, the proposed flutter requirements can be met with minimum cost and effects by use of the current state-of-the-art methods of balancing and structural fail-safe features.

One commentator agreed in principle with the proposal to revise § 23.629, but stated that suitable methods of compliance should be specified. The FAA does not believe the rule needs further change but will consider the issuance of guidance material as to applicable means of compliance.

Proposal 7–7. One commentator objected to the proposed amendment to § 23.677 concerning an aural warning device for certain longitudinal trim systems. The device would provide an aural warning when the horizontal stabilizer trim is in transit due to trim system operation or when the power or thrust controls are advanced to the takeoff position with the stabilizer trim set in a position outside the approved range for takeoff. The commentator stated that the warning would tend to be ignored in a cockpit environment which already contains many aural warnings. The commentator also objected to the cost and complexity that this requirement would add. The FAA agrees, and the proposal to add a new § 23.677(d) is withdrawn.

Proposal 7–8. No unfavorable comments were received on the proposal to amend § 23.701. However, after further review, the FAA believes that the proposed change is not appropriate and is not needed for Part 23 airplanes. The proposal is withdrawn.

Proposal 7–9. No unfavorable comments were received on the proposal to amend § 23.723(a) which would allow the use of analysis to supplement tests to substantiate landing load factors. However, the FAA has revised the proposal based on comments received on Proposal 7–34. See Proposal 7–34.

Proposal 7-10. Two commentators questioned the benefit of the ski shock absorption test in proposed §§ 23.737 and 25.737. The commentators noted that the conditions which may cause ski failure in service do not correspond to the conditions of the proposed shock absorption test. Based upon these comments and upon further review within the FAA, the FAA believes that it does not have enough information at this time to specify requirements for ski shock absorption tests and the proposals are withdrawn.

Proposal 7-11. No unfavorable comments were received on the proposal to add a new § 23.785(h). Accordingly, the proposal is adopted without substantive change. The proposal as adopted is redesignated as § 23.785(l) in view of the adoption of §§ 23.785(h), (i), (j), and (k) by Amendment 23-19 (42 FR 30601; June 16, 1977).

Proposal 7-12. No unfavorable comments were received on the proposal to add a new § 23.853(e). However, to ensure consistent interpretation, the applicable portions of Appendix F to Part 25 are set forth in a new Appendix F to Part 23, and the corresponding reference in the proposal is revised accordingly.

In addition, the FAA believes that the proposed requirement for a vertical self-extinguishing test may be unduly restrictive for electrical wire and cable insulation and for certain small parts. An exception is therefore provided for these items.

Proposal 7-13. One commentator agreed with the intent of the proposal to add a new § 23.863, but stated that without appropriate explanatory material, the proposed rule could be applied in a manner beyond the limits of cost and engineering practicality for many general aviation airplanes. The FAA will consider the issuance of appropriate guidance material. The proposal is adopted without substantive change.

Proposal 7-14. No unfavorable comments were received on the proposal to revise § 23.1307(a). However, a commentator suggested that a provision be added to allow the type design to include a seat or other facility (such as a stretcher) that is intended to be occupied on takeoff, during flight and on landing. The FAA believes that Part 23 airplanes utilized for a special purpose should be allowed to have installed berths, such as those approved under § 23.785, as well as approved seats. Proposed § 23.1307(a) is revised accordingly.

Proposals 5-7, 5-24, 5-41, 5-58, 2-84, 2-129, and 2-184. Proposal 5-7 of Airworthiness Review Notice No. 5 (Notice 75-23), to amend § 23.1329 is similar to proposals to amend §§ 25.1329 and 29.1329 and to the proposal to add a new § 27.1311 (Proposals 5-24, 5-58, and 5-41, respectively). Other related proposals affecting §§ 25.1329, 27.1329, and 29.1329 were included in Airworthiness Review Notice No. 2 (Notice 75-10) as Proposals 2-84, 2-129, and 2-184, respectively, and their disposition was deferred for consideration with Proposals 5-24, 5-41, and 5-58, respectively.

Several commentators objected to the above proposals. After consideration of the comments received, and after further review, the FAA believes that except for proposed §§ 23.1311(h) and 25.1329(h) of Proposals 5-7 and 5-24 respectively, which are discussed below, Proposals 2-84, 2-129, 2-184, 5-41, and 5-58 and the remainder of Proposals 5-7 and 5-24 are premature, and they are withdrawn.

One commentator objected to the language "means independent of the mode selector switch" in proposed § 23.1311(h) on the ground that it would require separation of the mode selector from the mode indicator, constituting an unnecessary and burdensome restriction for single and two-axis automatic pilot systems. The FAA believes, after further consideration, that the need to provide reliable mode selection information to the pilot exists only when the automatic pilot system can be coupled to airborne navigation equipment such as VOR and ILS (localizer and glide slope). Accordingly, the proposal is revised to incorporate that qualification.

Several commentators stated that the proposed requirement attempts to provide design details instead of stating the intent, which tends to retard advances in technology, and that it does not take into account modern panels which incorporate illuminated mode indications that give positive indication of the selected mode but are not "independent" of the mode selector switch. The FAA agrees that the proposed requirement is unnecessarily restrictive, and the proposals are revised to specify that selector switch position is not acceptable as a means of indication instead of requiring the means of indication to be independent of the selector switch.

Commentators objected to the phrase "and the availability status of each alternative system" in proposed §§ 23.1311(h) and 25.1329(h), contending that compliance may not be possible for some systems, and that even when possible, the added complexity would reduce reliability and create confusion in the cockpit. The FAA agrees, and the phrase is deleted.

One commentator suggested that proposed § 23.1311(h) be revised to require that the mode selector indication for the automatic pilot system differ from that for the flight director system. The FAA does not have sufficient information at the present time to justify imposing such a regulation. This commentator further suggested that when automatic pilot mode selection indication is provided for both pilot and copilot, those indications must agree. This would merely require that both mode selection indications be correct, and the FAA does not believe that the revision suggested by the commentator is necessary.

In view of the withdrawal of the proposals to redesignate § 23.1329 as § 23.1311 and to add a new § 23.1311(g), proposed § 23.1311(h) is redesignated § 23.1329(g) and is adopted with the revisions discussed above. Proposed § 23.1329(h) (Proposal 5-24) is adopted with the revision discussed above for § 23.1311(h).

Proposal 7-15. Several commentators objected to the wording "the highest loads expected in service under any loading condition" in the proposals to revise §§ 23.1413(a), 25.1413(b), 27.1413(a), and 29.1413 which would broaden the rated strength requirements for safety belts and harnesses. The commentators contended that this wording was unreasonable, vague, and would be difficult to administer. The FAA believes that research and development work in the area of full scale dynamic testing of airplanes and mathematical modeling of the man-seat combination is needed to develop a more definitive standard. The proposed revisions of §§ 23.1413(a), 25.1413(b), 27.1413(a), and 29.1413 are withdrawn.

Proposal 7-16. One commentator objected to the proposal to add a new § 23.1416 which would add pneumatic de-icer boot system requirements. The commentator stated that the words "any forseeable" in paragraph (b) are too broad and suggested that the nominal system operating parameters for each component should be used as a basis for establishing a factor of the nominal as design limit. The FAA disagrees that a factor is appropriate but agrees that the criteria should be revised. Accordingly, the words "any foreseeable" in proposed § 23.1416 are deleted and the words "any normal" are inserted in their place. The same commentator objected to the wording of proposed § 23.1416(c) on the ground that it could be interpreted to mean a pressure gauge would be required in the cockpit. The commentator recommended revising paragraph (c) to require that means be provided to indicate to the flight crew that the pneumatic de-icer boot system is receiving adequate pressure during the inflation cycle. The FAA agrees. This revision would make it clear that the use of pressure switches and indicator lights would be allowed in lieu of a pressure gauge. The proposal is revised accordingly.

Proposal 5-18. One commentator objected to the proposal to amend § 23.1545, contending that it would result in an unwarranted economic burden on aircraft owners. The FAA does not agree. The proposed requirement that the airspeed indicator be marked according to indicated airspeed is necessary to provide a more useful airspeed reference for operation of the airplane. In addition, the FAA does not believe that the proposed requirement would result in an appreciable increase in cost to aircraft owners compared to the current requirements.

Another commentator (who concurred with the proposed revision of § 23.1545) stated that the amount of information required on the airspeed indicator is reaching the point where confusion may be a factor, and that the reference to radials and arcs in § 23.1545 apparently prohibits the use of linear (horizontal or vertical) gauges. The FAA recognizes that indicator markings, if excessive, may cause confusion but believes that the proposed marking requirements are well within safe limits. With respect to linear-scale gauges, it is not the intent of the proposal to prohibit their use. The proposal, as well as present § 23.1545, describes marking for circular airspeed indicators since current airspeed indicators are circular. Analogous markings could be devised for linear-scale instruments and approved under airplane type certification equivalent safety provisions. Accordingly, the proposal to amend § 23.1545 is adopted without substantive change.

Proposal 8-22. For a comment related to proposed § 23.1557(f), see Proposal 8-24. The proposal is revised for the reasons discussed in Proposal 8-24.

Proposal 8-23. No unfavorable comments were received on the proposal to delete § 23.1583(l). Accordingly, the proposal is adopted without substantive change.

Proposed 8-24. Proposed §§ 23.1585(e) and (f), together with Proposal 8-23 for § 23.1583, would transfer information concerning the meaning of the zero fuel indication from the operating limitations section to the operating procedures section of the Airplane Flight Manual. One commentator stated that any reference to "fuel remaining" when the fuel quantity indicator reads "zero" invites pilot error or misinterpretation. The FAA does not agree. The reference to "fuel remaining" appears in the current rule, and the FAA does not have any information at this time to indicate that it has resulted in pilot error or misinterpretation. However, after further review, the FAA believes that the information that is required to be furnished under proposed § 23.1585(e) should be clarified in view of the fuel gauge calibration requirements set forth in § 23.1337(b)(1).

Accordingly, proposed § 23.1585(e) is revised by adding the language "in level flight" so that the section reads in part "* * * when the fuel quantity indicator reads "zero" in level flight, any fuel remaining in the fuel tank cannot be safely used in flight". Similar revisions are made to proposed §§ 25.1585(d), 27.1585(d), and 29.1585(d). Proposed §§ 23.1585(f), 25.1585(e), 27.1585(e), and 29.1585(e) are adopted without substantive change.

In view of the adoption of new §§ 23.1585(e), 27.1585(c), and (d), and 29.1585(c) and (d) in Airworthiness Review Amendment 6 (43 FR 2302; January 16, 1978), proposed §§ 23.1585(e) and (f), 27.1585(d) and (e), and 29.1585(d) and (e) are redesignated and adopted as §§ 23.1585(f) and (g), 27.1585(e) and (f), and 29.1585(e) and (f), respectively.

Proposal 7-17. The proposed amendment to § 25.305(d) and the proposed new Appendix G to Part 25 (Proposal 7-55) are being deferred until final rule making action is taken with respect to Airworthiness Review Notice No. 8 (Notice 75-31; 40 FR 29410; July 11, 1975).

Proposal 7-18. One commentator suggested that proposed § 25.331(a)(4) be revised to allow the trim system to operate at its maximum rate with normal aerodynamic load instead of requiring the flight test trim conditions specified in § 25.255. The FAA believes that there is insufficient data for rulemaking action to make the suggested revision. Another commentator recommended that proposed § 25.331(a)(4) be revised to exclude the effect of out-of-trim conditions as a consideration for the accelerated pitching conditions of proposed § 25.331(c) but retained for the zero pitching accelelation conditions of proposed § 25.331(c). The FAA disagrees. Out-of-trim conditions may exist in zero pitching acceleration maneuvers as well as in accelerated pitching maneuvers and should be considered in both cases. Section 25.331(a)(4) is amended as proposed.

One commentator suggested that proposed § 25.331(c)(1) be revised to clarify the type of pitching parameter to be considered, and to allow for the optional use of transient rigid body response for airplane loads. The FAA agrees. The use of transient rigid body response will yield conservative, but easier-to-calculate loads. The proposal is revised to allow for the use of transient rigid body response and to clarify the type of pitching parameter to be considered.

The same commentator suggested that proposed § 25.331(c) be revised to state that airplane loads which occur subsequent to the occurrence of maximum positive pitching acceleration need not be considered. The FAA disagrees. The commentator did not submit, and the FAA is not aware of, time-history data that shows that the transient down tail load will always reach its peak value at the same time that the elevator surface reaches its maximum prescribed throw and that the pitching acceleration will also always reach a maximum in the nose-up direction at the same time.

The same commentator further suggested that proposed § 25.331(c)(1) be revised to make the requirements applicable to configurations with conventional trailing-edge elevator controls, and that configurations using an all-movable horizontal stabilizer should be designed to the specified control displacements of current § 23.531(c)(3). The commentator stated that applying the proposed requirements to configurations using an all-movable horizontal stabilizer for primary pitching control results in an entirely different type of loading condition than was originally intended for elevator-controlled airplanes. This results, the commentator stated, from the fact that all-movable stabilizers have much lower rate capabilities than elevators; approximately 6 degrees per second for all-movable stabilizers versus 30 to 40 degrees per second for elevators. The FAA does not have sufficient data to support the distinction suggested by the commentator.

Another commentator objected to combining the requirements for "checked maneuver at speeds between V_A and V_D" and the requirements for "specified control displacement" in proposed § 25.331(c)(2). This commentator stated that he is not aware of any evidence that the present required levels of pitching acceleration have resulted in unsafe designs, and that the design requirement should involve either the use of rational time history analyses or, alternatively, the use of the present acceleration criteria. The proposal to amend § 25.331(c)(2) contains the current requirements except that a rational pitching motion-time profile is required rather than optional. The present acceleration criteria were derived from the behavior of airplanes much older than, and different from, those of current design. The FAA does not have enough information regarding the conservatism these criteria provide for modern designs. However, since the rational time history analysis method does consider the behavior of the modern airplanes, that method is specified.

Two commentators stated that proposed § 25.331(c)(2) is not clear with respect to whether pitching accelerations greater than the values quoted in the formula are to be used for design, and also stated that it does not define the control movement to be considered nor state whether the limit load factor must be reached. In addition to proposed § 25.331, the strength criteria contained in other sections of the subpart must be considered in establishing structural design criteria. With respect to control movement and load factor, the FAA does not have any information at this time which would indicate that specific constraints on control movement or load factor are necessary.

The proposal to amend § 25.331 is adopted with the revisions discussed above.

Proposal 7–19. Several commentators, including the initial public proponent, objected to the proposal to add a new § 25.341(d) to require the empennage to be designed for gusts which are not purely vertical or lateral in direction. The commentators referred to existing conservatisms in the rules which have resulted in satisfactory service experience to date, and stated the need for further review and evaluation. The FAA, upon further review, believes that there is insufficient data to substantiate the need for the additional requirement at this time. The proposal to add a new § 25.341(d) is withdrawn.

Proposal 7–20. One commentator objected to deletion of the words "as speed brakes" in the proposal to amend § 25.345(c). The commentator stated that the removal of the words "as speed brakes" would increase structural weight, not only in the flaps, but also in the wings and horizontal tail. The FAA agrees that airplane loads, and weight, may increase as a result of this proposed amendment. However, the FAA believes that an airplane should be designed for any condition in which the airplane is normally operated. Airplanes are now commonly flown in en route conditions with flaps deployed for purposes other than as speed brakes, and the airplane structure should be designed for the appropriate loads regardless of the operational reason. Another commentator objected to the deletion of the words "as speed brakes" on the ground that removal would leave unanswered questions on flaps up-down cycling, gust encounters, upsets, and overspeed. The FAA does not have any information at this time which indicates that additional requirements related to these factors are necessary. The amendment to § 25.345(c), is adopted as proposed.

Two commentators suggested rewording the proposed new § 25.345(d) by replacing the word "landing" with the word "maneuvering" to make it clear that the proposed requirement is not intended as an additional landing condition to be investigated under § 25.473. The FAA believes that the suggested rewording would lead to a possible misunderstanding due to altitude effects which may result in a more severe load being applied to the airplane. The intent of the proposal is to provide an additional landing condition to be investigated, but not under § 25.473, at maximum takeoff weight with a maneuvering load factor of 1.5g and the flaps and similar high lift devices in the landing configuration. Accordingly, the proposed new § 25.345(d) is adopted without substantive change.

Proposal 7-21. Several commentators stated that the proposal for § 25.351(a), which would extend the upper limit of the speed range specified in current § 25.351(a) from V_A to V_D, is unduly severe and recommended that the pilot's maximum rudder pedal force be 300 pounds from V_{MC} to V_A and 200 pounds from V_C/M_C to V_D/M_D with linear variation between V_A and V_C/M_C. In addition, one commentator stated that the proposed extension of the upper limit of the speed range would penalize aircraft utilizing manual control systems. The commentator further stated that reducing rudder control force at the higher speeds would be consistent with probable operational practice. The FAA believes that the capability of current jet transports for high rudder forces throughout the design envelope has resulted in a high degree of structural integrity during recovery maneuvers, and that this capability must be ensured in future designs. The proposal to amend § 25.351(a) is adopted without substantive change.

Proposal 7-22. Two commentators expressed a need for clarification of the terms "sudden engine stoppage" as used in the proposal to amend § 25.361(b) and "torque for maximum continuous take-off power" as used in the proposed lead-in of § 25.361(c). Actually the word "take-off" did not appear in Notice 75-26. However, since both terms occur in the current rule and were used in the same sense in the proposal, the FAA does not believe further clarification is needed. Accordingly, the proposal is adopted without substantive change.

Proposal 7-23. All of the comments received in response to proposed § 25.491 either questioned the definition of the words "roughest runway and taxiway profiles to be expected in normal operations", or questioned the means of showing compliance. Two commentators stated that the costs of conducting dynamic analyses are high and that the proposal would cause an unjustified economic penalty by requiring dynamic analyses whether needed for a particular configuration or not. The FAA agrees that a more specified proposal is needed. The proposal to revise § 25.491 is withdrawn.

Proposal 7-24. Although no unfavorable comments were received on the proposed new § 25.499(e), two commentators stated that some factor above the nominal values of torque and static reaction is needed to cover possible increases of loads. The FAA does not believe at this time that a factor for nose gear loads due to steering is needed. Accordingly, the proposal is adopted without substantive change.

Proposal 7-25. One commentator objected to the 1.5g rearward ultimate inertia force requirement of the proposed § 25.561(b)(3)(v) because of inadequate substantiation. The commentator stated that the current research on crashworthiness should be completed before the proposal is finalized. After consideration of this comment, and after further review, the FAA agrees that the proposal to add a new § 25.561(b)(3)(v) is premature, and it is withdrawn.

After consideration of the comments received on the proposal to add a new § 25.561(d) concerning structural crashworthiness requirements for certain multi-deck airplanes, and after further review, the FAA believes that it does not have enough information to set forth a rule of general applicability at this time. Accordingly, the proposal to add a new § 25.561(d) is withdrawn.

Proposal 7-26. After consideration of the comments received on the proposal to add a new § 25.563(b), concerning structural ditching requirements for certain multi-deck airplanes, and after further review, the FAA believes that it does not now have enough information to set forth a general standard which would be appropriate for both partial and full multi-deck configurations. The proposal to add a new § 25.563(b) is withdrawn.

Proposal 7-27. The proposal to revise § 25.571(c)(1), concerning fatigue requirements, is withdrawn in view of the separate rulemaking action that has been initiated to consider the fatigue requirements for transport category airplanes (see Notice 77-15; 42 FR 41236; Aug. 15, 1977).

Proposal 7-28. For comments related to the proposal to add a new § 25.603(c), see Proposal 7-3.

Proposal 7-29. One commentator objected to the proposed amendment to § 25.605(b) which would require that new aircraft fabrication methods be substantiated by a test program. The commentator stated that, to meet current § 25.605, manufacturers presently conduct many tests before new fabrication methods are used, especially where the airworthiness of the airplane is involved. The commentator felt that the present regulations are adequate and questioned the need for a test program requirement since this would require specific FAA approval of the test program. Such approval, the commentator stated, would only increase the expense and require additional time to coordinate. The FAA does not agree that current § 25.605 is adequate. Current § 25.605 requires only that the processes requiring close control to produce a consistently sound structure be performed under an approved process specification. The FAA believes that the proposed rule is necessary to ensure that all new aircraft fabrication methods are tested to determine their soundness. In addition, the manufacturers who currently perform an adequate test program should have no difficulty in meeting the proposed requirement. The proposal to amend § 25.605 is adopted without substantive change.

Proposal 7-30. No unfavorable comments were received on the proposal to amend § 25.613(e). Accordingly, the proposal is adopted without substantive change.

Proposal 7-31. One commentator recommended that the proposed amendment to § 25.629(d)(1)(ii) be revised to include the words "affecting divergence or flutter". The FAA does not believe the change is needed since words to this effect are used in the lead-in of present § 25.629(d)(1).

One commentator objected to the requirement in proposed § 25.629(d)(1)(ii) that freedom from flutter or divergence be shown for any combination of failures not shown to be extremely improbable. The commentator stated that the cost would far outweigh any theoretical improvement to safety over what is presently provided. The FAA disagrees. Service experience has shown that combinations of failures can be expected and, therefore, unless combinations of failures are shown to be extremely improbable, they must be considered in design for freedom from flutter and divergence.

One commentator recommended that the proposed § 25.629(d)(4)(vi) requirement for consideration of any single failure in any flutter damper system be revised to exclude active control systems for damping and apply only to flutter dampers connected to a control surface. The FAA disagrees. Failures in all flutter damping systems must be considered if the freedom-from-flutter requirement of § 25.629(d)(1) is to be demonstrated. The proposal is adopted without substantive change.

Proposal 7-32. One commentator on the proposed amendment to § 25.697(b), concerning lift and drag device controls, recommended that the word "inadvertent" in both sentences of the proposal be replaced with the word "unintentional" or "unintended". The FAA does not believe that a clarification would result from the recommended revision. The proposal is adopted without substantive change.

Proposal 7-33. One commentator objected to proposed § 25.701(a) which would provide for the use of equally reliable means instead of a mechanical interconnection for the synchronization of flaps on opposite sides of an airplane. The commentator questioned what would be as reliable as mechanical interconnection. The FAA believes that there are devices which are available or may become available that are at least as reliable as a mechanical system in this application and would be acceptable alternatives. However, to clarify the intent of the proposed rule, the proposal is revised to read "approved equivalent means" instead of "equally reliable means".

Proposal 7-34. One commentator recommended that proposed § 25.723(a) be revised to state that the analysis which may be used to substantiate landing gear limit load factors for increases in takeoff and landing weights must be based on identical landing gear systems. The commentator expressed the opinion that the use of the word "similar" might cause confusion and allow deviations from the original intent that the analysis must be based on landing gear tests conducted on a landing gear system with identical, not similar, energy absorption characteristics. The FAA agrees, and the proposal is revised accordingly.

Proposal 7-35. For a discussion of the withdrawal of proposed § 25.737, see proposal 7-10.

Proposal 7-36. One commentator opposed the proposal to add a new § 25.773(d) to add markers or other guides to enable pilots to position themselves for optimum outside visibility and instrument scan. The commentator stated that he knew of no airplane that has a position for maximum outside visibility that coincides with optimum eye position for instrument scan. Another commentator concurred with the proposal but recommended that it be revised to clarify that the optimum "combination" of outside visibility and instrument scan is sought. The FAA agrees that what is intended is an optimum combination, and proposed new § 25.773(d) is revised accordingly.

Proposal 7-37. No unfavorable comments were received on the proposal to amend § 25.777. Accordingly, the proposal is adopted without substantive change.

Proposal 7-38. Several commentators objected to the requirements of proposed new § 25.789(b) that would require each major galley component, including serving carts, drawers, and compartments, to have a placard indicating its maximum load. The commentators stated that drawers and compartments are designed for weights that can reasonably be expected in service. Two commentators stated that placarding galley components would not increase the level of safety for the occupants of the airplane, and would not guarantee adherence to the indicated maximum load during operation. Based on these comments, and upon further review within the FAA, the proposed new § 25.789(b) is withdrawn.

No unfavorable comments were received on proposed new § 25.789(c). Accordingly, the proposal is adopted without substantive change and redesignated as § 25.789(b).

Proposals 7-39 and 7-79. Numerous commentators objected to Proposal 7-39 to add a new § 25.802 to establish standards for evacuation alarm systems, and to Proposal 7-79 to add a new § 121.292 to require that evacuation alarm systems be installed on all passenger-carrying airplanes. After considering the comments received, and after further review, the FAA believes that rulemaking on the subject of evacuation alarm systems in passenger-carrying airplanes is premature. Accordingly, the proposals to add new §§ 25.802 and 121.292 are withdrawn.

Proposal 7-40. Proposed § 25.803(c) would replace the present emergency evacuation demonstration conditions with conditions which satisfy both Part 25 and Part 121, thus providing for one demonstration that serves both airworthiness and operational requirements. One commentator stated that the aircraft manufacturer should not be the sole demonstrator of emergency evacuations and recommended that more than one demonstration be required to rule out a "long shot" success. The commentator did not present any data to show that additional demonstrations by persons other than the manufacturer are needed. The FAA believes that demonstrations made under the prescribed conditions and using the prescribed procedures will yield comparable results, and that the manufacturer is competent to conduct such demonstrations.

Two commentators objected to proposed § 25.803(c)(4) which would require that the airplane's normal electrical power sources be de-energized and stated that the existing wording "using only the emergency lighting system" is preferred. The FAA agrees and § 25.803(c)(4) is revised to state that only the airplane's emergency lighting system may provide illumination, except as noted in paragraph (c)(1).

No unfavorable comments were received on proposal § 25.803(c)(5), to require that all emergency equipment must be installed in accordance with §§ 25.1411 and 25.1415. However, the FAA believes that the proposal may be misconstrued, since certain operating rules of the chapter also state emergency equipment installation requirements. Proposed § 23.803(c)(5) is revised to specify that all emergency equipment that is required for the planned operation of the airplane must be installed.

A statement of required crewmember qualifications was inadvertently omitted from proposal § 25.803(c). Present Part 121 App. D paragraph (a)(12) states a requirement for a regularly scheduled line crew, and present § 25.803(c)(6) states a requirement merely for persons who have knowledge of the exits and emergency equipment. The FAA believes that the training and knowledge levels associated with a regularly scheduled line crew are appropriate for any demonstration that is conducted for the introduction of a type and model of airplane into passenger-carrying operations, whether the demonstration is conducted for compliance with Part 121 alone or for dual compliance with Parts 25 and 121. Accordingly, the crew requirements of present Part 121 App. D paragraph (a)(12) are set forth as new § 25.803(c)(7)(i). The crew requirements of present § 25.803(c)(6) have been shown adequate for airplane type certification under Part 25. These requirements are set forth in a new § 25.803(c)(7)(ii) to provide for situations where separate demonstrations of compliance with type certification and operating rules may be necessary or appropriate.

One commentator suggested deletion of the requirements of §§ 25.803(c)(7)(ii) and (c)(7)(iii) requiring at least 5 percent of passengers be over the age of 60 and 5–10 percent be children under the age of 12 years. The FAA believes that age distribution should be considered in the selection of test subjects, and that the proposed requirements are realistic in terms of the age distribution of airline passengers. The proposed §§ 25.803(c)(7)(ii) and (c)(7)(iii) are adopted without substantive change. One commentator requested that, due to laws governing employment and insurance for persons under 18 years of age, § 25.803(c)(7)(iii) be modified to provide an equivalency by adding the words "or at least 5 percent, but not more than 10 percent must be adults between the ages of 50 to 60 years of age." A second commentator suggested essentially the same wording, citing data showing comparable evacuation times for persons under 12 and in the 50 to 59 age group and relating one instance where this equivalency was allowed during evacuation testing. The FAA does not now have enough information on evacuation times for the various age groups to revise the proposal in the manner suggested by these commentators. One commentator recommended that proposed § 25.803(c)(7)(iv) be modified to require the three life-size dolls to have height and weight equivalent to a child. The FAA believes the terms "life-size" and "simulate live infants" adequately express this intent. The proposed § 25.803(c)(7)(iv) is adopted without substantive change.

One commentator stated that reference to the words "crewmembers, mechanics, and training personnel" in § 25.803(c)(7)(v) is only appropriate if tests are being conducted by the operator rather than the manufacturer. The FAA disagrees since such training personnel are also employed by the manufacturer. Accordingly, § 25.803(c)(7)(v) is adopted as proposed.

One commentator suggested that the carry-on baggage, blanket, and pillow requirements of § 25.803(c)(10) be deleted since there would be a reduced risk of injury during the test without significant effect on the results. The FAA does not agree since such items are intended to help simulate actual emergency evacuation conditions and might significantly affect the results of an evacuation test. Proposed § 25.803(c)(10) is adopted without substantive change.

One commentator suggested that § 25.803(c)(12) should state that no "prior" indication may be given of the exits to be used and that the word "advised" is more appropriate in § 25.803(c)(14) than the word "warned". The FAA agrees with both clarifications and the amendments are revised accordingly.

Although no adverse comments were received on the proposed requirements for multi-deck airplanes in § 25.803(c)(16), the FAA believes that it does not now have enough information to establish comprehensive evacuation criteria for multi-deck airplanes and the multi-deck requirements of § 25.803(c)(16) are deleted.

One commentator objected to the requirement in proposed § 25.803(c)(18) that all the emergency equipment that is normally available, including slides, ropes, lights, and megaphones, must be fully utilized during the demonstration. The commentator stated that the utilization of ropes and megaphones places an undue and unrealistic burden on the evacuation demonstration. The commentator believes that the use of ropes at overwing exits introduces the hazard of tripping and entanglement, and could result in a reduced evacuation flow rate, and that the use of megaphones limits the ability of the flight attendant to effect rapid egress of participants by denying the use of one hand and by restricting the line of vision. The commentator also objected that the use of two or more megaphones simultaneously during the demonstration could confuse and misdirect evacuees. The FAA recognizes that certain items of emergency equipment are installed for purposes other than evacuating occupants from an airplane after an aborted takeoff and that a need to control the use of communications devices may exist. These factors should be considered in each applicant's approved procedures. Proposed § 25.803(c)(18) is amended to state that the applicant's approved procedures must be fully used during the demonstration.

Several commentators objected to the proposed amendment to § 25.803(d) which would allow analysis in showing that the airplane is capable of being evacuated within 90 seconds. One commentator stated that analysis alone is an incomplete means of showing compliance and should not be allowed. Another commentator stated that extrapolations based on analytical testing have no practical relation to actual conditions which occur in accidents and in evacuation demonstrations. The FAA agrees that the limitations on the use of analytical procedures should be made clear. The requirement that the Administrator find the analysis data acceptable was intended to preclude approvals which might be based on insufficient test data, such as in the case of a completely new airplane model or a model which has major changes or a considerably larger passenger capacity than a previously approved model.

Accordingly, § 25.803(d) is revised to clarify the intent.

No unfavorable comments were received regarding proposed §§ 25.803(c)(1), (c)(2), (c)(3), (c)(6), (c)(7)(i), (c)(8), (c)(9), (c)(11), (c)(13), (c)(15), and (c)(17). Accordingly, these proposals are adopted without substantive change.

It should be noted that the deletion of several proposed paragraphs and the insertion of a new § 25.803(c)(7) has required the redesignation of the adopted paragraphs.

The proposal to revise §§ 25.803(c) and (d) is adopted with the changes discussed above.

Proposal 7-41. One commentator objected to the proposal to revise § 25.807(a)(7)(vi), stating that a flight attendant seat can be so mounted relative to an exit or to other seats that the flight attendant's access to the exit itself is restricted. The commentator recommended that the proposal be revised to specify that forward facing seats be placed aft of the emergency exit, and aft-facing seats be placed forward of the emergency exit, so that no flight attendant is seated with the attendant's back to the exit. The intent of the proposals to revise § 25.807(a)(7)(vi) is to specify that the seat required by present § 25.807(a)(7)(vi) must be a flight attendant seat which complies with the requirements of §§ 25.785(h) and (i). The FAA is not aware of any unsatisfactory service history with respect to the orientation of seats provided in accordance with present § 25.807(a)(7)(vi), and the commentator did not provide any information which would indicate that a problem exists. The FAA believes that revising the proposal in the manner suggested by the commentator would unduly restrict design. Accordingly, the proposal is adopted without substantive change.

Proposed § 25.807(c)(7) is based on the existing special conditions developed for the current wide body jet airplanes. Based on the comments received, and upon further review within the FAA, the FAA believes that it does not have enough information to adopt a rule of general applicability to multi-deck airplanes at this time. Proposed § 25.807(c)(7) is withdrawn.

Proposal 7-42. Several commentators objected to proposed new § 25.809(f)(1)(iv) which would require that the emergency exit means to assist the occupants in descending to the ground be usable without outside assistance in 25-knot winds. One commentator stated that the proposed section was not clear with respect to whether deployment into a 25-knot wind was required in addition to operation in 25-knot winds after deployment. Proposed § 25.809(f)(1)(iv) is revised to state the requirement more clearly. Another commentator proposed that the weight of one person on the device be allowed to ground it to make it usable. The FAA agrees that the assistance of one person should be allowed. Proposed § 25.809(f)(1)(iv) is revised accordingly. In response to another comment questioning the state-of-the-art, the FAA believes that the proposed requirement, as revised to allow the assistance of one person after deployment, is within the state-of-the-art.

Another commentator stated that the provision concerning wind force direction in proposed § 25.809(f)(1)(iv) was vague. The FAA disagrees since the critical wind direction may vary for each assisting means and the applicant must demonstrate which direction is most critical.

Several commentators objected to the 98 percent reliability requirement in proposed new § 25.809(f)(1)(v) as being difficult to interpret given a relatively small sample size and indicated that tests conducted on new designs may not adequately represent the reliability level in service. Another commentator stated that the reliability requirements in proposed § 25.809(f)(1)(v) were excessive and unwarranted. The FAA believes that the evaluation of slide designs during airplane type certification does establish a level of in-service performance if the slides are maintained properly. The FAA agrees, however, that the amount of testing that would be required to obtain data for the proposed determination of 98 percent reliability may be excessive for the systems under consideration. A more direct testing method, requiring fewer tests, has been found to provide an acceptable measure of egress system reliability in recent airplane type certifications. Proposed § 25.809(f)(1)(v) is revised to specify the use of that method.

One commentator asked how the inertial forces specified in proposed § 25.809(f)(1)(v) would be applied. In practice, this has been done by applying equivalent static loads. (Clearly, test methods will have to be developed for dynamic testing if future designs indicate a need for it.) This commentator also asked whether the last sentence of proposed § 25.809(f)(1)(v) is necessary. The FAA believes that with the test method specified, the testing series must be restarted following failure to ensure that the reliability assessment is valid. The last sentence of § 25.809(f)(1)(v) has been rewritten to make this clear.

Proposal 7-43. One commentator objected to proposed § 25.811(e), stating that the present operating instructions have historically proven adequate to open doors and that there is no need for the additional requirements. The FAA does not agree and believes that the need for the proposed requirements has been established by recent adverse service experience.

One commentator questioned whether proposed § 25.811(e)(2) is applicable to Type II exits. The FAA is unaware of any need for extending this requirement to Type II exits at this time. Consistent with the proposal, the requirement applies only to Type A and Type I exits.

One commentator recommended that proposed §§ 25.811(e)(2)(i), (e)(2)(ii), and (e)(3) be revised to require that a minimum brightness remain after a substantial amount of weathering in service. The FAA believes that a requirement for a minimum brightness belongs in the operating rules and that it is correctly stated in § 121.310(e)(2) of the Federal Aviation Regulations.

Another commentator suggested that the alternative requirements for Type I and Type A passenger exit operating handles set forth in proposed § 25.811(e)(2)(i) and (ii) be made applicable to Type III exit operating handles. The FAA does not agree. The alternative provisions referred to are allowed for Type I and Type A exits because a specified level of illumination must be provided at these exits. However, since illumination levels are not specified for all Type III exit installations, a self-illuminated operating handle must be provided.

One commentator objected to the proposed ±0.5-inch tolerance for the location of the projected point of the arrow for rotary handle markings. The commentator indicated that current door rigging variations cannot always meet the proposed tolerance. The FAA agrees. To allow for rigging variations, proposed § 25.811(e)(4)(ii) is revised to require that centerline of the exit handle be within ±1-inch of the projected point of the arrow when the handle has reached full travel and has released the locking mechanism.

One comment on proposed § 25.811(e)(4)(ii) suggested that no marking is a substitute for having a door mechanism designed so that it is unmistakable when full travel of the mechanism has been reached. It is not clear what the commentator is recommending. However, the proposal requires marking of the handle position at the full travel limit, after the locking mechanism has been released. Since persons unfamiliar with the mechanism may be required to operate it in an emergency, the marking is needed to ensure that they move the handle to full travel against any resistance which may be felt.

Proposed § 25.811(e) is adopted with the revision discussed above. In addition, several nonsubstantive changes have been made for clarity.

Proposal 7-44. No unfavorable comments were received on the proposal to amend § 25.812(e). Accordingly, the proposal is adopted without substantive change.

Two commentators questioned proposed §§ 25.812(f) and (g) to provide emergency lighting coverage with the airplane in abnormal attitudes. One of the commentators contended that present standards have historically provided satisfactory lighting and that a "battery of lights" would be necessary to comply with the proposal. Based on the comments received, and after further review within the FAA, the proposed changes to §§ 25.812(f) and (g) are withdrawn.

Several commentators objected to the proposal to add a new § 25.812(1). One commentator stated that the meaning of "high intensity" is subject to broad interpretation and that a flashlight could provide an acceptable level of illumination. Current § 121.549 (b) provides for a readily available flashlight for each crewmember, and the FAA believes that the intent of the proposal can be met by specifying an accessible flashlight storage means. The proposal to add a new § 25.812(1) is withdrawn and Proposal 7-81 for § 121.301(1) is revised to require flashlight stowage provisions that are readily accessible from each flight attendant seat and to allow 2 years for compliance.

Proposal 7-45. One commentator objected to the proposal to revise § 25.813(c)(1) to add a requirement that "there must be no interference in opening the exit." The commentator considered this proposal to be interpretive material better suited for Advisory Circular action and stated it was not clear. The FAA disagrees. Many emergency exits need more clearance than the projected exit opening to prevent interference when opening the exit, and this proposal would make it clear that adequate clearance is required. The commentator suggested adding after the word "protrusions" the words "to prevent exit door ready removal" in § 25.813(c)(1). The FAA does not believe proposed § 25.813(c)(1) needs clarification, and the suggested wording could lead to misinterpretations.

Another commentator recommended that the requirement of § 25.813(c)(1) be applied to airplanes having 9 to 19 passenger seats. The FAA disagrees. Current requirements of § 25.813(c)(2) consider emergency exit access for airplanes having 19 or less passengers. Service experience has shown no need to change the requirements of § 25.813(c)(2).

After consideration of the comments received, and after further review, the FAA believes that proposed § 25.813(g) to establish material and systems requirements and proposed §§ 25.813(h) and (i) to establish passageway design requirements are premature, and they are withdrawn.

Proposal 7-46. In view of the amendment of § 25.831 by Airworthiness Review Amendment No. 5 (42 FR 36960; July 18, 1977), the FAA believes that proposed § 25.831(g) is not necessary and it is withdrawn.

Proposal 7-47. No unfavorable comments were received on the proposal to amend § 25.863. One commentator asked for an explanation of the means to show compliance with the proposed requirements of paragraph (d). The areas where flammable fluids or vapors could escape by the leakage of a fluid system must be identified and defined as part of type design data submitted by the applicant for type certification. The proposal is adopted without substantive change.

Proposal 8-43. One commentator contended that proposed § 25.901(d) will be difficult to administer because the term "applicable provisions of this subpart" will not be consistently interpreted. The commentator suggested that the applicable provisions be clearly defined. The FAA does not agree with the commentator and believes the suggested revision is unnecessary. The same wording is used in current § 25.901(b)(1) with respect to propulsion powerplant installations, and has been administered without difficulty.

One commentator suggested that only those auxiliary power units (APU) that are classed as essential power units need to meet the applicable provisions of the subpart. Several other commentators suggested that the applicable provisions should be clearly defined to differentiate between essential and nonessential APU installations. The FAA does not agree with these comments. The FAA believes that appropriate requirements for safety must be applied to all APU installations. No justification has been shown for the operation of a nonessential or a ground operation only APU at a safety level that is different from that which is required for an essential APU.

The proposal is adopted without substantive change.

Proposal 8-46 and 3-35. Disposition of Proposal 3-35 to amend § 25.1103 (Notice 75-19) was deferred so that it could be considered in connection with Proposal 8-46. One commentator on Proposal 3-35 suggested that the proposed revision to § 25.1103(d), concerning ducts other than induction system ducts, be placed in a separate section of Part 25. The FAA believes that it is more appropriate to include the requirement in § 25.1103 and to expand the heading of that section to include a reference to air duct systems. Proposal 3-35 is adopted without substantive change. However, § 25.1103(d) as adopted reflects a change proposed by Proposal 8-46. With respect to Proposal 8-46, one commentator suggested that the phrase "unless it can be shown that a duct failure will not result in an additional fire hazard" be added to proposed § 25.1103(b). The FAA does not believe that the suggested condition could be met. The ducts under consideration are those which are contained within fire zones, including the auxiliary power unit fire zone. Duct failures in such areas could allow fire to spread, possibly outside the fire zone, or could reduce the effectiveness of installed fire-extinguishing systems.

Several commentators suggested that it would be difficult to establish the "sufficient distance upstream of the auxiliary power unit compartment" specified in proposed § 25.1103(e). The FAA believes that the proposed standard is appropriate. In this instance, a more definitive standard, taking into account all of the factors that might be involved, would tend to restrict design flexibility unnecessarily.

One commentator objected to proposed § 25.1103(e), contending that its language precluded the use of methods to prevent hot gas reverse flow, which would provide at least an equivalent level of safety. The FAA knows of no practical method other than fireproofing to prevent hot gas reverse flow in induction system ducts. If such a method were developed, the applicant could apply for its approval under the "equivalent safety" provisions of § 21.21(b)(1). This commentator also contended that if proposed § 25.1103(f) is met, it is unrealistic to consider a fire caused by hot gas reverse flow burning in the air induction system. The commentator suggested, instead a requirement to determine the maximum intake duct temperature that could occur under hot gas reverse flow conditions and to use a duct material that can resist these temperatures. The commentator apparently misinterpreted the proposal. Proposed § 25.1103(e) requires that certain portions of each auxiliary power unit induction system duct be fireproof, and proposed § 25.1103(f) states heat tolerance requirements for those portions of the induction system other than those which are specifically required to be fireproof. However, the FAA believes the proposed language may be unclear. Therefore, that portion of § 25.1103(f) which states requirements for the heat tolerance of materials is revised to clarify the applicability and is moved to § 25.1103(e).

Two commentators suggested that proposed § 25.1103(f) be revised to allow the use of materials that may absorb or trap non-hazardous quantities of flammable fluids (or flammable fluids that could present a hazard to the aircraft). These commentators contended that proposed § 25.1103(f) would prevent the use of certain sound suppression materials that trap small quantities of fluids. The FAA agrees and § 25.1103(f) is revised accordingly.

One commentator suggested that an acceptable alternative to compliance with proposed § 25.1103(f) would be to show that any fire which may occur is contained within the induction system. The FAA does not believe that it would be possible to contain a fire in the induction system since the induction system is a passage which is open at both ends.

Substantively identical revisions are made to Proposal 8-73 for § 29.1103.

Proposal 8-47. Two commentators on proposed § 25.1142 stated that there was no need for starting control on the flight deck for auxiliary power units (APU) that are operable only on the ground. The FAA believes that any APU installed on the airplane, whether or not intended only for ground use, should be able to be operated by the flight crew since its improper operation or malfunction could affect the safety of the aircraft. The commentators appear to have interpreted the proposal to apply to both the APUs which are installed in the airplane and to those stationary, portable, or mobile units which are external to the airplane and are considered to be ground support equipment. The proposal is therefore revised to clarify that it is applicable only to installed APUs.

One commentator stated that APU and engine standards in Part 25 should be separated to ensure consistent administration. The FAA does not agree with this commentator, and believes the suggested revision is unnecessary. The APU and engine standards in Part 25 have been administered without difficulty for years.

Another commentator stated that the proposal should be revised to differentiate between essential and non-essential APUs. For a discussion of this comment, see Proposal 8-43.

Proposals 8-49 and 3-41. Disposition of Proposal 3-41 to amend § 25.1195(b) (Notice 75-19) was deferred so that it could be considered in connection with Proposal 8-49. One commentator objected to Proposal 3-41 and suggested that it be revised to read "* * * all extinguishers are not required to crossfeed all engines, but two shots to each engine are required." The proposal deletes the last sentence of present § 25.1195(b) to avoid the possible interpretation that a particular discharge must be directable to every fire zone. Such an arrangement would be acceptable, but individual systems which have a dual discharge capability may be confined to serve a particular fire zone. The proposal is considered equivalent to the wording preferred by this commentator.

Another commentator stated that the proposal does not meet the intent of the explanation unless the last sentence of present § 25.1195(b) is deleted. The proposal includes this deletion. This commentator further stated that the proposed wording contradicts the exemptions allowed by § 25.1195(a). The FAA does not agree. Section 25.1195(b) applies only to non-excepted fire zones. Proposal 3-41 to amend § 25.1195(b) is adopted without substantive change.

One commentator objected to the requirement in Proposal 8-49 for § 25.1195(b) that the test fully simulate actual critical airflow conditions, stating that there should be provisions in the regulations to allow the use of test results and analysis to show compliance. Another commentator objected to the proposal because it does not allow demonstration of compliance by a combination of analysis and analogy with similar engine installations that have been subjected to full scale fire tests. The FAA does not agree with these comments. Distribution of the extinguishing agent within a fire zone is a controlling factor in extinguishing a fire within that fire zone. No acceptable procedure has been found to demonstrate extinguishing agent concentration by analysis, or by reference to tests or service experience on similar powerplant installations, or by reference to tests conducted under conditions other than those encountered in service. Compliance with proposal § 25.1195(b) must be based on actual or simulated flight tests which fully provide the critical airflow conditions to be encountered in flight.

One commentator objected to the words "under critical airflow conditions," "any fire," and "preventing reignition" as meaningless when engine breakup or cowling damage occurs. A second commentator objected to the proposal because no hole size is specified. However, the proposal is based on the assumption that the fire zones under consideration remain intact, with no engine breakup or cowling damage and with only those holes that are present during normal operation. Therefore, no damage factors are specified.

Several commentators objected to the words "and preventing reignition" for the reason that there is no practical way to determine compliance unless the fire and potential reignition sources are defined. These commentators suggested that this requirement should be changed to "and minimize the probability of reignition." The FAA agrees that the language "and preventing reignition" may imply that extinguishing agent concentration must be maintained indefinitely. The FAA believes that this is beyond the present state-of-the-art, and the proposal is revised in the manner suggested by these commentators. Three of these commentators further objected to the proposed requirement for an extinguishing agent concentration capable of "extinguishing any fire" in a fire zone because there is no practical way to determine compliance unless the fire is defined. The FAA agrees, and the proposal is revised to incorporate the words "extinguishing fires" to be consistent with the provisions of present § 25.1195(b).

One commentator stated that the use of full-scale fire tests, evidence of similar powerplant configurations, and analysis were proposed as part of Airworthiness Review Notice No. 3 (Notice 75-19; 40 FR 21866; May 19, 1975) to show compliance with the requirements of §§ 25.1181 through 25.1203, and that this proposal is in conflict with

Notice 75-19. The proposal in Notice 75-19 to which the commentator refers has been adopted as § 25.1207 (Airworthiness Review Amendment No. 4, effective May 2, 1977). Section 25.1207, as adopted, provides for those cases when tests are specifically required. However, in light of the adoption of proposed § 25.1195(b), the FAA believes that § 25.1207 could be confusing and it is revised for clarity. Additionally, this commentator stated that the method of demonstrating satisfactory fire extinguishing capability should be by agreement between the manufacturer and the certificating authority. The FAA does not agree. Objective rules are needed to ensure that a consistent level of safety is maintained.

One commentator stated that the proposal refers to critical airflow conditions while the explanation refers to flight conditions, which are not necessarily the same thing. The FAA agrees that clarification is necessary. The proposal is revised to specify critical airflow conditions in flight.

Proposal 8-49 to amend § 25.1195(b) is adopted with the revisions discussed above. Similar revisions are also made in connection with Proposal 8-75 for § 29.1195(d).

Proposal 7-48. No unfavorable comments were received on the proposal to amend § 25.1307(a). Accordingly, the proposal is adopted without substantive change.

Proposal 5-24. For comments related to the proposal to revise § 25.1329(b), see Proposal 5-7.

Proposal 7-49. One commentator suggested deletion of the words "Such as automatic life raft releases" from proposed § 25.1411(a)(1) since they imply that the requirement is intended to apply only to equipment for ground emergency use. The FAA agrees. This implication is not intended, and the proposal is revised in the manner suggested by this commentator.

Several commentators objected to proposed § 25.1411(a)(2) and to its companion proposal for § 121.309(a)(2) (Proposal 7-80) regarding accessibility of standard emergency equipment to flight attendants. In light of the comments received, and after further review, the FAA believes that it should not be required that safety equipment such as fire extinguishers, portable oxygen bottles, and first aid kits be positioned adjacent to each flight attendant seat and be readily accessible to the seated flight attendant. From a safety standpoint, it is not essential that this equipment be used from a seated position, and from a practical standpoint it would be difficult to provide for the installation of the equipment in the confined areas proposed. Safety equipment should be installed in accessible areas of the aircraft where it would be available during an emergency. However, the FAA believes that when a public address system is provided in compliance with the operating rules of this chapter, the flight attendant seated in any of the seats located adjacent to a floor level exit may be required to use the public address system. Therefore, at least one public address system microphone intended for flight attendant use should be positioned at each floor level exit and be readily accessible to a flight attendant seated in any seat adjacent to the exit. The proposal to amend § 25.1411(a)(2) is revised accordingly. The proposal for § 121.309(a)(2) is revised in a substantively identical manner and is adopted as part of § 121.318(b), which is concerned with public address systems.

One commentator objected to the proposed amendment in § 25.1411(a)(2) that "no equipment may be located as to adversely affect the safety of the flight attendant under any condition," stating that compliance would be clearly impossible to achieve. The FAA agrees that the proposed requirement may be too restrictive and it is deleted.

No unfavorable comments were received on the proposal to add a new § 25.1411(b)(3). The FAA believes that the requirements to identify the contents of storage compartments and containers are adequately covered in § 25.1541(c). The proposal for § 25.1411(b)(3) is withdrawn.

No unfavorable comments were received on the proposal to amend § 25.1411(d) and it is adopted without substantive change.

Two commentators objected to the proposal to add a new § 25.1411(h) which would require that emergency equipment be clearly marked to indicate its method of operation if it is not obvious. The commentator objected to passengers operating emergency equipment without assistance from flight attendants and also pointed out that current § 25.1561 already requires the marking of safety equipment as to its method of operation. After further review, the FAA believes that although crewmembers are not always available, the current marking instructions set forth in § 25.1561 cover passenger use. Proposed new § 25.1411(h) is withdrawn.

Proposal 7-50. The proposal to amend § 25.1413(b) is withdrawn. For comments related to the withdrawal, see Proposal 7-15.

Proposal 7-51. Two commentators objected to the proposal to add a new § 25.1415 (b)(4), which would require that one-half of the non-portable rafts be considered unusable for ditching. The commentators stated that the requirement that one-half of the rafts be considered unusable is unrealistic. The FAA does not agree since a non-portable raft, or a raft which by design cannot be used at other than its primary exit, may not be operable if that exit malfunctions or if ditching conditions are such that that exit cannot be used. However, after consideration of the comments received, and after further review, the FAA believes that it does not have enough information to prescribe a rule of general applicability for the design of ditching provisions which incorporate nonportable rafts. Accordingly, proposed new § 25.1415(b)(4) is withdrawn. The FAA believes that with the withdrawal of proposed § 25.1415(b)(4), the reference to portable rafts that is contained in proposed § 25.1415(b)(3) may be interpreted as allowing the use of nonportable rafts. This effect is not intended, and proposed new § 25.1415(b)(3) is withdrawn.

Several commentators objected to the proposal to add a new § 25.1415(b)(5), which would require that means be provided to assist the airplane's occupants in boarding the rafts from the airplane without entering the water. The commentators contended that for certain sea conditions no means has been demonstrated for boarding rafts from airplanes without the possibility of the occupants entering the water. The FAA agrees and proposed new § 25.1415(b)(5) is withdrawn.

Proposal 7-52. No unfavorable comments were received on the proposal to add a new § 25.1416 which adds pneumatic de-icer systems requirements. However, the FAA has revised the proposal based on the comments received on Proposal 7-16. See Proposal 7-16.

Proposal 7-53. Several commentators recommended revisions to the proposal to add a new § 25.1423 which would establish intercommunication equipment requirements for multideck airplanes. One commentator recommended that the lead-in paragraph be revised to make the requirements applicable to airplanes with adjacent occupiable decks or compartments (excluding lavatories) and that the intercommunication and the two-way alert means be required between each occupiable deck or compartment and the flight deck. The same commentator recommended that the intercommunication system and the two-way alert means be capable of providing crewmembers on all decks or occupiable compartments an immediate indication of an emergency situation on any deck or occupiable compartment (excluding lavatories). In the light of the comments received, and after further review, the FAA believes that it does not now have enough information to specify intercommunication equipment requirements appropriate for all transport category airplanes. The proposal to add a new § 25.1423 is withdrawn.

Proposal 8-57. One commentator suggested that proposed new § 25.1522 be revised so that it would also apply to auxiliary power units (APU) that do not meet the requirements of TSO-C77 (§ 37.183). The FAA does not agree. The proposal recognizes that operating limitations established under a TSO do not have to be reestablished as a part of airplane type certification. However, an airplane type certificate applicant would have to develop appropriate operating limitations during the airplane type certification for any installed APU not manufactured under the provisions of a TSO. Such APU operating limitations would then become part of the aircraft type design. The proposal has no applicability in the situation discussed by the commentator.

Another commentator, while agreeing with the proposal, suggested that proposed § 25.1522 be revised to require also that each APU meet the requirements of TSO-C77. The FAA does not agree. TSO-C77 is applicable only to gas turbine powered APU's.

The suggested revision would require that APU's other than gas turbine units be manufactured to the standards which are appropriate to, and established only for, the manufacture of gas turbine auxiliary power units.

The proposal is adopted without substantive change.

Proposal 7-54. One commentator objected to the proposal to amend § 25.1561(c) which makes clear that the removal of required emergency equipment from the stowage provisions be "easy." The commentator suggested replacement of the word "facilitate" between the words "and" and "removal" with the words "provide easy accessibility and rapid" in § 25.1561(c). The FAA does not believe that the recommended revision is necessary to accomplish the intent of the proposal and the proposal is adopted without substantive change.

Proposal 8-60. No unfavorable comments were received on the proposal to delete § 25.1583(g). Accordingly, the proposal is adopted without substantive change.

Proposal 8-61. For a comment related to the proposal to amend § 25.1585, see Proposal 8-24. Proposed § 25.1585(d) is revised for reasons stated in the discussion of Proposal 8-24. Proposed § 25.1585(e) is adopted without substantive change.

Proposal 7-55. For a discussion of the deferral of the proposal to add a new Appendix G to Part 25, see Proposal 7-17.

Proposal 8-63. No unfavorable comments were received on the proposal to revise § 27.79(b)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 7-56. For comments related to the proposal to add a new § 27.603(c), see Proposal 7-3.

Proposal 7-57. For comments related to the proposal to amend § 27.605, see Proposal 7-29.

Proposal 7-58. One commentator apparently misunderstood the proposed addition to the lead-in of § 27.613(d). The commentator stated that the proposal did not change the current rule. However, the proposal would add the words "or other values approved by the Administrator," to the lead-in. With this change, the Administrator may allow the applicant greater flexibility in the selection of design values. The proposal is adopted without substantive change.

Proposal 7-59. Several commentators objected to the proposed amendments of §§ 27.671 and 29.671 on the ground that they would require extensive redundancy in the mechanical portion of the flight control system and require that the rotorcraft be capable of continued safe flight and landing if all engines fail. The commentators stressed that no current state-of-the-art designs can meet the proposed requirements and that redundancy may cause less reliable structure as a result of extreme complexity. One commentator stated that adequate safety can be achieved by proper design and fatigue testing and analysis. After consideration of the comments received, and after further review, the FAA believes that it does not have enough information at this time to set forth an appropriate general standard for control system performance following failure or malfunction. The proposed changes to §§ 27.671 and 29.671 are withdrawn.

Proposal 7-60. No unfavorable comments were received on the proposal to revise § 27.675(d)(1). Accordingly, the proposal is adopted without substantive change.

Proposal 7-61. The proposed deletions of §§ 27.695 and 29.695 are related to the proposed revisions of §§ 27.671 and 29.671. In consideration of the withdrawal of the proposed revision of §§ 27.671 and 29.671, the proposed deletions of §§ 27.695 and 29.695 are withdrawn. See Proposal 7-59.

Proposal 7-62. Several commentators objected to the requirement in proposed §§ 27.737 and 29.737 that compliance with shock absorption tests must be demonstrated with ski components installed on rotorcraft. The commentators emphasized that the design of helicopter landing gear, such as standard skid designs, is such that ski installations will not generally change energy absorption characteristics. The FAA agrees. The proposals to amend §§ 27.737 and 29.737 are withdrawn.

Proposal 7–63. Several commentators objected to the proposed amendment to § 27.853 which would impose certain of the compartments interior fire protection requirements for transport category airplanes on normal category rotorcraft. The commentators stated that these proposed requirements are not reasonable for normal category rotorcraft and are more severe and more restrictive than the current requirements for normal category airplanes. The FAA agrees, and the proposal to amend § 27.853 is withdrawn.

Proposal 7–64. Two commentators objected to the proposal to add a new § 27.863 that would require protection from a flammable fluid or vapor fire outside the engine compartment. The commentators stated that the small, unsophisticated fluid carrying systems in normal category rotorcraft make this an unnecessary and expensive compliance item without increasing safety. The FAA disagrees. The agency believes that the smaller and less complex fluid carrying systems will be able to meet this requirement with correspondingly small and simple means. The proposal is adopted without substantive change. Also see the comments for Proposals 7–47 and 7–75.

Proposal 7–65. The proposal to amend § 27.1413(a) is withdrawn. For comments related to the withdrawal, see Proposal 7–15.

Proposal 7–66. Several commentators objected to the proposals to add new §§ 27.1463 and 29.1463 to require a means to prevent persons from inadvertently contacting the tail rotor of a rotorcraft. The comment was made that the only practical way to prevent a person from contacting a tail rotor is to make it physically impossible for the person to reach the tail rotor. This could be accomplished by raising the tail rotor or by using shrouds and screens. On smaller rotorcraft shrouds and screens would have to be used to prevent tail rotor contact by a person since it would be impossible to raise the tail rotor sufficiently. It was contended that providing a shroud and screen of sufficient strength and rigidity to accomplish its purpose, without itself causing a hazard due to deformations to be expected in service, would add excessive weight in a weight critical area of many rotorcraft designs. The FAA agrees with these comments and after further consideration the proposals to add new §§ 27.1463 and 29.1463 are withdrawn.

Proposals 5–51 and 5–65. Two commentators objected to proposed §§ 27.1545(a) and 29.1545(a) on the ground that these provisions are appropriate only to fixed-wing aircraft. Apparently these commentators construed the reference to paragraph (b) in proposed §§ 27.1545(a) and 29.1545(a) as referring to the markings specified in proposed § 23.1545(b). However, the paragraph (b) that is referred to in proposed § 27.1545(a) is current § 27.1545(b), and the paragraph referred to in proposed § 29.1545(a) is current § 29.1545(b). Sections 27.1545(b) and 29.1545(b) have not been changed. Accordingly, the proposals to revise §§ 27.1545(a) and 29.1545(a) are adopted without substantive change.

Proposal 8–65. No unfavorable comments were received on the proposal to delete § 27.1583(f). Accordingly, the proposal is adopted without substantive change.

Proposal 8–66. No unfavorable comments were received on the proposal to amend § 27.1585; however, proposed § 27.1585(d) is revised for reasons stated in the discussion of Proposal 8–24. Proposed § 27.1585(e) is adopted without substantive change. In view of the adoption of new §§ 27.1585(c) and (d) in Airworthiness Review Amendment No. 6 (42 FR 2302; January 16, 1978), proposed §§ 27.1585(d) and (e) are redesignated and adopted as §§ 27.1585(e) and (f), respectively.

Proposal 8–68. In the proposed amendment of § 29.75, one commentator objected to the use of the 50-foot height criterion for the determination of Category A landing distance. The commentator suggested a rewording that was identical to the proposal except that the 50-foot height criterion would be replaced by a requirement that the approach flight path cross the edge of the heliport at an altitude of 25 feet or less. According to the commentator, the 50-foot altitude criterion is inconsistent with past practices of some certification programs and there has been no adverse experience with the use of a 25-foot altitude "window." The FAA does not agree with the commentator. The FAA is aware of only one instance in which a 25-foot height criterion was used. In that instance, a 25-foot height was specified for landing operations to be conducted on a 2,300-foot runway. The FAA is not aware of any certification experience involving the use of a range of altitudes over the edge of the heliport (the "altitude window" concept) in the determination of Category A landing distances.

The commentator also suggested that the Category A performance requirements should be edited as a group and put into language which is understandable to people who work with helicopters. However, the commentator did not make any specific recommendations, and the FAA has no information which would indicate that Category A performance requirements are difficult to understand.

The proposal to amend § 29.75 is adopted without substantive change.

Proposal 7-67. For comments related to the proposal to add a new § 29.603(c), see Proposal 7-3. Section 29.603(c), as adopted, differs from the proposal for the reasons discussed in Proposal 7-3.

Proposal 7-68. For comments concerning the subject matter of the proposal to amend § 29.605, see Proposal 7-29. The proposal is adopted without substantive change.

Proposal 7-69. No unfavorable comments were received on the proposal to amend § 29.613(d). Accordingly, the proposal is adopted without substantive change.

Proposal 7-70. The proposal to amend § 29.671 is withdrawn. For a discussion of the withdrawal, see Proposal 7-59.

Proposal 7-71. No unfavorable comments were received on the proposal to amend § 29.675(d)(1). Accordingly, the proposal is adopted without substantive change.

Proposal 7-72. The proposal to delete § 29.695 is withdrawn. For discussion related to the withdrawal, see Proposal 7-61.

Proposal 7-73. The proposal to amend § 29.737 is withdrawn. For discussion related to the withdrawal, see Proposal 7-62.

Proposal 7-74. Several commentators objected to the proposal to amend § 29.853, which would impose certain of the compartment interior fire protection requirements for transport category rotorcraft. The commentators cited the favorable service experience to date, the smaller cabins of transport category rotorcraft relative to transport category airplanes, the ability of helicopters to land quickly, and the fact that helicopter cabins are not pressurized, as reasons not to impose transport category airplane requirements on transport category rotorcraft. The FAA disagrees. The service experience cited is based on the relatively small current civil fleet of transport category rotorcraft. However, the current fleet is increasing in size both with respect to the number of rotorcraft and with respect to the size of rotorcraft.

In response to another comment, proposed § 29.853(a) has been further revised to set forth the applicable requirements contained in §§ 25.853(a) and (b) rather than cross referencing those regulations.

However, the cross-reference to Appendix F of Part 25 for test procedures has been retained. See also the discussion of Proposal 7-12.

Proposal 7-75. Two commentators objected to the proposal to revise § 29.863 on the ground that the present regulations provide an adequate level of safety without adding unnecessary cost to the certification program. The FAA believes that the proposed requirements are necessary to ensure protection from a flammable fluid or vapor fire. The proposal is adopted without substantive change. Also see the discussion of Proposals 7-47 and 7-64.

Proposal 8-69. No unfavorable comments were received on the proposal to amend § 29.901. For comments related to the like proposal to amend § 25.901, see Proposal 8-43. The proposal is adopted without substantive change.

Proposal 8-70. One commentator objected to the requirements in proposed § 29.923(a) that the tests be conducted on the rotorcraft and that the test torque be absorbed by the actual rotors to be installed. This commentator stated that the testing of larger drive systems while installed on the rotorcraft is impractical and, in some cases, unconservative in view of the manner in which the rotorcraft must be attached to the ground to absorb the powers involved. Another commentator also objected to the requirement that the 200-hour test be conducted on the rotorcraft. This commentator stated that for conventional rotorcraft with anti-torque tail rotors, or those with contra-rotating rotors, the test purpose could be fulfilled by conducting the test on a suitable rig, if it can be demonstrated that the distortion and vibration conditions are the same as those met on the rotorcraft. The requirements to which these commentators objected are contained in present § 29.923 and were merely restated for clarity in the proposal. Further, the FAA believes these requirements are necessary to ensure the validity of the test results.

One commentator suggested that for clarity § 29.923(a) should read "* * * for at least 200 hours plus any extra time required to meet paragraphs (b)(2) and (k) of this section where more than two engines are fitted in the rotorcraft." The FAA believes that the applicability of §§ 29.923(b)(2)(ii) and (k)(2) to multi-engine rotorcraft is clearly stated and that the revision suggested by this commentator is unnecessary.

The proposal to amend § 29.923 is adopted without substantive change.

Proposals 8-71 and 2-164. Disposition of Proposal 2-164 to amend § 29.927 (Notice 75-10, 40 FR 10802; March 7, 1975) was deferred so that it could be considered in connection with Proposal 8-71. One commentator on Proposal 2-164 to amend § 29.927(b)(2) questioned whether due consideration had been given to the 30-minute emergency power rating when establishing the 15-minute time requirement for the torque transmission test. The 30-minute training is substantiated by the endurance testing specified in proposed § 29.923, while the proposed 15-minute time requirement is associated with testing which must be done if turbine engine output can exceed the highest engine or transmission torque limit and that output is not directly controlled by the pilot under normal operating conditions. The highest engine or transmission torque limit is usually associated with takeoff torque, and the 15-minute test would be done at a torque level substantially higher than that associated with the 30-minute rating. The FAA therefore believes that due consideration has been given to the 30-minute ratings, and Proposal 2-164 is adopted without substantive change.

One commentator on Proposal 8-71 agreed with the concept that the overspeed test should be a "proof" test, but questioned the use of maximum continuous speed as a datum. The commentator stated that the use of 120 percent of maximum continuous speed would be acceptable provided this value is at least equal to 105 percent of rotor never-exceed speed and 115 percent of takeoff speed. Maximum continuous speed is used as a reference speed in other required testing of the rotor drive system, and the FAA believes it is appropriate to retain it for consistency. Further, the FAA does not have any information at the present time to indicate that the additional requirements recommended by the commentator are necessary.

One commentator objected to the provisions "After completion of the 200-hour, tie-down test and without intervening major disassembly" in proposed § 29.927(d). The FAA agrees that this provision is inappropriate. The intent of the proposal was to disassociate the overspeed test from the 200-hour, tie-down test since the tests are unrelated. The proposal is revised by striking the words "After completion of the 200-hour, tie-down test and without intervening major disassembly."

Proposal 8-72. No unfavorable comments were received on the proposal to amend § 29.1091 and it is adopted as proposed.

Proposal 8-73. For comment related to the proposal to revise § 29.1103, see Proposal 8-46. The proposal is revised for the reasons discussed in Proposal 8-46.

Proposal 8-74. One commentator objected to the requirement in proposed § 29.1142 that controllability from the flight deck must be provided for auxiliary power units (APU), contending that nonessential APUs should be excluded from the requirement. The FAA does not agree. The commentator has not presented any reason to justify distinguishing between APUs on the basis of the essential or nonessential nature of the services provided by the APU. The FAA believes the flight crew should be provided a means to control an emergency involving any installed auxiliary power unit.

For reasons that are stated in the discussion of Proposal 8-47, proposed § 29.1142 is revised by inserting the word "installed" between the words "each" and "auxiliary."

Proposal 8-75. For comments related to a proposal similar to the proposal for § 29.1195(d), see Proposal 8-49. Section 29.1195(d), as adopted, differs from the proposal for the reasons discussed in Proposal 8-49.

Proposal 7-76. The proposal to amend § 29.1413 is withdrawn. For a discussion of the withdrawal, see Proposal 7-15.

Proposal 7-77. The proposal to add a new § 29.1463 is withdrawn. For a discussion of the withdrawal, see Proposal 7-66.

Proposal 8-76. No unfavorable comments were received on the proposal to add a new § 29.1522. For comments related to the proposal to add a new like section under

Part 25, see Proposal 8-57. The proposal to add new § 29.1522 is adopted without substantive change.

Proposal 5-65. For comments related to the proposal to revise § 29.1545(a), see Proposal 5-51. The proposal is adopted without substantive change.

Proposal 8-78. No unfavorable comments were received on the proposal to delete § 29.1583(g). Accordingly, the proposal is adopted without substantive change.

Proposal 8-79. No unfavorable comments were received on the proposal to amend § 29.1585; however, proposed § 29.1585(d) is revised for reasons stated in the discussion of Proposal 8-24. Proposed § 29.1585(e) is adopted without substantive change. In view of the adoption of new §§ 29.1585(c) and (d) in Airworthiness Review Amendment No. 6 (43 FR 2302; January 16, 1978), proposed §§ 29.1585(d) and (e) are redesignated and adopted as §§ 29.1585(e) and (f), respectively.

Proposal 7-78. One commentator suggested that the proposal to amend § 121.291 be revised to allow an air carrier to utilize the results of an evacuation demonstration conducted by another air carrier to eliminate the need for an additional demonstration. The purpose of the proposed amendment to § 121.291 and the related proposals to revise § 25.803(c) (Proposal 7-40) and to delete paragraph (a) of Appendix D to Part 121 (Proposal 7-84) is to specify conditions for an emergency evacuation demonstration to be conducted during type certification, which meets both airworthiness and operational needs. The FAA does not believe that any further relaxation of the current requirement that a Part 121 operator conduct a demonstration in addition to that conducted during type certification of the airplane, is justified. This commentator also recommended revising the proposal to require a demonstration upon a major change in cabin interior configuration that significantly affects the emergency evacuation duties of crewmembers. The FAA believes that present § 121.291(a)(2) adequately provides for the situation described by the commentator.

One commentator suggested that paragraph (a) of Appendix D to Part 121 be retained since there are certain differences in wording between that paragraph and § 25.803(c) which would be inappropriate. After consideration of this comment, and upon further review, the FAA agrees that paragraph (a) of Appendix D to Part 121 contains certain requirements for emergency equipment installation, for seating density and arrangement, and for crewmember qualifications which are appropriate to an emergency evacuation demonstration conducted by an operator and which should be retained. Proposal 7-84 to delete paragraph (a) of Appendix D is withdrawn, and the reference to that paragraph which appears in present § 121.291(a) is retained.

Proposal 7-79. The proposal to add a new § 121.292 is withdrawn. For a discussion of comments related to the proposal, see Proposal 7-39.

Proposal 7-80. For discussion concerning the revision of the proposal for § 121.309 (a)(2), see Proposal 7-49. Since provisions for a public address system and its use are currently provided under § 121.318, the FAA believes that substance of the proposed § 121.309(a)(2), as revised, is more appropriately stated in § 121 318, and that section is revised accordingly. The provision for a delayed effective date has been retained but extended to 2 years.

The proposal to add a new § 121.309(a)(3) is withdrawn since the proposed requirements are adequately covered in § 121.309(b)(4).

While no unfavorable comments were received on the proposal to amend § 121.309 (b)(3), upon further review the FAA believes that the current requirement adequately covers identification and marking of equipment operation. Accordingly, the proposal is withdrawn.

Proposal 7-81. Several commentators objected to the proposal to amend § 121.310(a), which would require that existing aircraft comply with the emergency evacuation slide requirements in proposed § 25.809(f)(1) within 2 years of the effective date of this amendment. The commentators stated that 2 years would not be enough time to develop and test emergency evacuation slides complying with proposed § 25.809(f)(1) and to retrofit them to existing aircraft. One commentator further objected that the design development and testing needed would constitute an undue burden for the operator, and that there is no assurance that the proposed criteria could be applied retroactively to all airplanes. The FAA agrees, and the proposal to amend § 121.310(a) is withdrawn.

One commentator stated that the requirement in proposed new § 121.310(d)(4), that each emergency light have a cockpit control device with "on", "off," and "armed" positions 1 year after the effective date of the amendment, may be too restrictive, particularly for large fleet operators. Upon further consideration, the FAA believes the retrofit requirement should be extended to two years. Proposed new § 121.310(d)(4) is revised accordingly.

For a discussion of the revision to proposed § 121.310(1), see Proposal 7-44.

Proposal 7-82. One commentator objected to the proposal to revise § 121.319(b)(1) to require two-way communication between the pilot compartment and all the galleys and other flight attendant stations on the ground that the proposed requirement would result in unnecessary redundancy and would not be cost effective. The commentator agreed with a requirement for interphones for only those galleys physically isolated from the passenger compartment. Two other commentators stated that adequate communication could be provided without interphones at each flight attendant station and galley because of the close proximity of some flight attendant stations to galleys. Another commentator suggested that the interphone be required only at required flight attendant stations. The FAA agrees that the intent of the proposal can be accomplished without requiring a means of communication to all galleys and other flight attendant stations. Accordingly, the proposal is revised to require a means of two-way communication between the pilot compartment and each galley which is located on other than the main passenger deck level and each passenger compartment.

One commentator stated that the installation of the proposed two-way communication system would require the modification of aircraft and therefore requested a delayed effective date. The FAA agrees and the proposal is revised to provide 2 years for compliance with the new requirement.

Additionally, §§ 121.313(b)(3), (b)(4), and (b)(5) are revised for consistency with the proposal for § 121.319(b)(1) by deleting the words "the passenger compartment" and substituting the words "each passenger compartment" in their place.

Proposal 7-83. One commentator stated that under the proposed rule it is conceivable that an aircraft of 300 passenger capacity might have its raft requirement satisfied with three rafts of 100 person capacity each, and considered such compliance to be impractical from the standpoint of passenger flow, urgency of evacuation at the time of ditching, and the number of exits available to those surviving passengers. The commentator recommended that the minimum number of life rafts be equivalent to the number of exits for launching of life rafts and for exiting of passengers of the ditched aircraft. The FAA does not have sufficient information at the present time to justify requiring more life rafts than would be required by proposed § 121.339(a)(2).

One commentator recommended that the proposal to amend § 121.339(a)(2) be revised to use the wording in § 25.1415(b)(1). The FAA agrees. The proposed amendment to § 121.339(a)(2) was intended to update it to agree with the requirements of § 25.1415(b)(1). The proposal is revised accordingly.

Proposal 7-84. The proposal to delete paragraph (a) of Appendix D to Part 121 is withdrawn. For discussion of the withdrawal, see Proposal 7-78.

ADOPTION OF THE AMENDMENTS

Accordingly, Parts 23, 25, 27, 29, and 121 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, and 121), are amended, effective December 1, 1978.

(Secs. 313(a), 601, 603, 604, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424), sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).)

Amendment 25-47

Operations Review Program: Amendment No. 10

Airworthiness, Equipment, and Operating Rules

Adopted: October 17, 1979 **Effective: December 24, 1979**

(Published in 44 FR 61323, October 23, 1979)

SUMMARY: The purpose of these amendments is to update and improve certain requirements applicable to airworthiness, aircraft equipment, and operations. These amendments are part of the Operations Review Program and are based on a compilation of proposals prepared for the Operations Review Conference.

FOR FURTHER INFORMATION CONTACT:

Mr. Norman C. Miller, Safety Regulations Staff, Regulatory Review Branch, AVS-22, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591, telephone 202-755-8715.

SUPPLEMENTARY INFORMATION

History

These amendments are the tenth in a series of amendments to be issued as part of the Operations Review Program. The following amendments of the series have previously been issued as part of the Operations Review Program:

Amdt. No.	*Title*	*Federal Register (FR) Citation*
1	Clarifying and Editorial Changes	(41 FR 47227; October 28, 1976)
2	Rotorcraft External-Load Operations	(42 FR 24196; May 12, 1977, amended by 42 FR 32531; June 27, 1977)
2A	Special Federal Aviation Regulation No. 36, Development of Major Repair Data	(43 FR 3084; January 23, 1978)
3	Airspace, Air Traffic and General Operating Rules	(44 FR 15654; March 15, 1979)
4	Miscellaneous Amendments	(43 FR 22636; May 25, 1978)
5	Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft	(43 FR 22643; May 25, 1978) amended by 43 FR 28403; June 29, 1978)
6	General Operating and Flight Rules and Related Airworthiness Standards and Crewmember Training	(43 FR 46230; October 5, 1978)

These amendments are based on a Notice of Proposed Rule Making (Notice 78-12) published in the FEDERAL REGISTER on August 24, 1978 (43 FR 37958). All interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review by the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below these amendments and reasons for their adoption are the same as those contained in Notice 78-12.

Discussion of Comments

The following discussions are keyed to the like-numbered proposals contained in Notice 78-12.

Proposal 10-1. Several commenters objected to proposed § 25.772(a) stating that: (1) the possibility of door jamming is remote due to aircraft design; (2) cockpit crash axes offer an equivalent method; (3) maintenance and cockpit security would be adversely affected; and (4) a conflict exists between this proposal and §§ 25.772 and 25.809(b).

Some airplanes are designed to preclude floor deformation and subsequent door jamming; however, this proposal provides for and door jamming condition which could occur regardless of aircraft design. The use of a crash axe does not provide the same degree of access to the passenger compartment from the cockpit. Under certain conditions, the crash axe may not provide access until a considerable period of time has elased. Cockpit security would not be compromised since the requirement applies to new designs and allows sufficient design flexibility.

There is no conflict between this proposal and §§ 25.772 and 25.809(b) as stated by the commenter. Current § 25.772 requires that crewmembers have access to emergency exits without using cockpit doors, while this proposal provides for access to the cabin area if the cockpit door becomes jammed. Section 25.809(b) concerns the deformation of emergency exits and not cockpit doors.

One commenter objected to the use of the word "means" since the word implies a special device and suggested wording of a more general nature. The word "means" is not restrictive and its use in the regulation provides the necessary flexibility. One commenter believed the proposed requirement would not be appropriate for cargo or cargo/passenger configurations. With respect to a cargo only configuration, there are no passengers to assist, and it is unnecessary for the crew to have access to the passenger compartment. With respect to the passenger/cargo configuration, the FAA has determined that the means for access to the passenger compartment must be available and proposed § 25.772 is revised by providing this access.

Proposal 10-2. One commenter objected to proposed § 25.809(f)(1)(iii) stating that redesigning all slides to be equally effective with the aircraft in various positions would be difficult and recommended that the proposal be withheld until a different design concept is developed. Present provisions in § 25.809(h) require that slides be self-supporting after collapse of one or more legs of the landing gear. After further review, it appears desirable to retain these provisions and add to them, as provided in the Notice, the provision that the slide provide safe evacuation of the occupants to the ground. It is not anticipated that this provision would require a different design concept than currently employed.

Another commenter recommended revisions to the proposal that would provide exception from the requirement if the slide is fitted on an exit that is not suitable for use after a minor crash landing. Exit suitability is not solely predicated upon minor crash landings and therefore does not represent a design condition which could be satisfied under this comment. Accordingly, proposed § 25.809(f)(1)(iii) is adopted as noted.

Proposal 10-3. The Society of Automotive Engineers, Inc., objected to proposed § 25.812 stating that the problem in the two cases cited in the National Transportation Safety Board report (NTSB-AAS-74-3), referred to in the Notice, was due to crew training and not the failure of the lighting system. In both cases, poor crew coordination and not the failure of the lighting system resulted in improper activation of the emergency lighting during evacuation. They also stated that in some aircraft which utilize fuselage-mounted floodlights for escape device illumination, valuable illumination of the area surrounding the escape device permits safe movement of evacuees away from the crash site. These floodlights also assist rescue teams in rapidly locating the portion of the wreckage containing survivors in times of darkness. Modification to reconnect these floodlights to an escape-device-lighting-system instead of the cabin emergency lighting system would create a less reliable system, considering the additional switches (or erection sensing devices) and wiring harness which would be necessary to connect the escape device to the floodlights on the fuselage. The SAE Committee considered the proposed rules concerning emergency lighting of exterior escape devices and the time compliance limitations to be necessary, economically unjustified and not necessarily in the best interest of safety. After review of these comments and in conjunction with studies conducted by the agency regarding the current lighting requirements, the FAA has determined that safety would not be improved as a result of this proposal and accordingly proposed § 25.812 is withdrawn.

Proposal 10-4. Six commenters objected to proposed § 21.310(h)(1)(iii) stating the cost of retrofitting all airline aircraft would be prohibitive and unwarranted. For example, three major airlines estimated that the cost of such a retrofit would be approximately $971,000, $608,399, and $870,000 respectively per fleet, and believe the proposal should be withdrawn. The FAA has analyzed these figures and determined they accurately reflect the retrofit cost burden that would be imposed on these airlines. In light of this determination and the fact that proposed § 25.812 (Proposal 10-3) has been withdrawn and in accordance with Executive Order 12044, and the Department of Transportation Regulatory Policies and Procedures which are intended to reduce the unnecessary burden on the public, the FAA concludes that this proposal would impose financial burdens on the public not commensurate with an increase in safety. Accordingly, proposed § 121.310(h)(1)(iii) is withdrawn.

Proposal 10-5. Several commenters objected to proposed § 121.313(f) contending that the proposal should be withdrawn because it is economically unjustified, and limits the designer's options in its applicability to existing airplanes, with possible compromise in cockpit security. They believe that to design, test, fabricate, install, and certificate such a type of egress to meet the intent of this proposal would have a cost impact of more than $100,000 per aircraft. The FAA acknowledges that there is merit to these contentions since retrofit of existing aircraft would be difficult and expensive. Accordingly, proposed § 121.313(f) is withdrawn.

Proposal 10-6. No unfavorable comments were received on the proposed revision to § 127.103(b). However, this proposal will require the replacement of many existing altimeters. Additionally, the FAA has determined that a one-year period should be allowed for manufacture, transportation, and installation of this equipment. Accordingly, this proposal will not become effective until one year after the effective date of these amendments.

Proposal 10-7. One commenter stated that the proposed requirement for a passenger's name and home address has no effect on flight safety and increases paperwork, time, and cost. Another commenter objected because the proposal would create an economical and operational burden. The commenter stated that it is difficult to obtain the additional information from passengers during flights having short time periods between connecting flights, or on international flights where passengers do not speak English. The commenter also stated that fixed-wing air carriers are not required to obtain this information. This statement is partially correct. Current Part 121 requires supplemental air carriers and commercial operators to include passenger names, but not addresses, on the load manifest. The FAA proposed in Notice No. 78-7 (43 FR 20448; May 11, 1978), to extend this requirement to domestic and flag air carriers.

In view of the comments received and after further review, proposed § 127.305 is revised by deleting "home addresses" and by inserting the word "persons" in place of "passengers".

Proposal 10-8. No unfavorable comments were received on the proposed revision to § 127.307(a). Accordingly, the proposal is adopted without substantive change.

Proposal 10-9. The majority of the commenters objected to the proposal to limit the duration of the Part 137 operator certificate to twenty-four months stating that the proposal is unnecessary, serves no useful purpose, and would not enhance safety. They stated that this proposal would: (1) impose an unnecessary burden on the legitimate operator; (2) require additional paperwork; (3) possibly cause administrative problems during renewal certification; (4) not improve the availability of the transient type operators to the FAA; and (5) create a financial hardship to the agricultural aircraft operator if a delay in the renewal process causes that operator's certificate to expire during the busy season.

As stated in the Notice, the FAA has difficulty in adequately monitoring the activities of these certificate holders to assure compliance with and understanding of applicable rules. However, as stated by one commenter, this regulation would probably not improve the availability of transient-type operators since many would change their place of business after renewal. For this reason, and in accordance with Executive Order 12044 and the Department of Transportation Regulatory Policies and Procedures which are intended to reduce the unnecessary burden on the public, the FAA concludes that this proposal would impose administrative burdens on the FAA and the public not commensurate with an increase in safety. Accordingly, proposed § 137.15 and related revisions to §§ 137.19 and 137.21 are withdrawn.

Proposal 10-10. See Proposal 10-9 for a discussion of comments related to the proposed amendment to § 137.19 and for the withdrawal of that proposal.

Proposal 10-11. See Proposal 10-9 for a discussion of comments related to the proposed revision to § 137.21 and for the withdrawal of that proposal.

Proposal 10-12. Two commenters stated the proposed shoulder harness requirement was already covered in § 91.7(b). The FAA does not agree. Current § 91.7(b) provides only for the fastening of shoulder harnesses during takeoff and landings and not during the entire flight operation. Many of the commenters concurred with the use of seat belts and shoulder harnesses but objected to a mandatory requirement because it would curtail the pilots discretion in using them.

Other commenters contend that the use of shoulder harnesses could restrict the pilot's movement in performing required duties during certain operations.

In view of these comments and after further review the FAA agrees that under certain operations shoulder harnesses could interfere with pilot duties. Accordingly, proposed § 137.42 is revised to except the use of shoulder harnesses if the pilot is unable to perform required pilot duties with the shoulder harness fastened.

Adoption of the Amendments

Accordingly, Parts 25, 127, and 137 of the Federal Aviation Regulations (14 CFR 25, 127, and 137) are amended effective December 24, 1979.

(Secs. 313, 314, and 601 through 610, Federal Aviation Act of 1958 (49 U.S.C. 1354, 1355, and 1421 through 1430) and section 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).)

Note.—The Federal Aviation Administration has determined that this document involves a regulation which is not significant under Executive Order 12044, as implemented by the Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final evaluation prepared for this document is contained in the docket. A copy of it may be obtained by writing to the person and address listed under "For Further Information Contact".

Amendment 25-48

Aircraft Wheels and Wheel-Brake Assemblies

Adopted: November 21, 1979 **Effective: December 31, 1979**

(Published in 44 FR 68738, November 29, 1979)

SUMMARY: The purpose of this amendment is to revise the Technical Standard Order (TSO) for aircraft wheels and wheel-brake assemblies and related type certification requirements for airplane brakes. As revised, the standards will incorporate updated and improved minimum performance standard for the design and construction of aircraft wheels and brakes.

FOR FURTHER INFORMATION CONTACT: Mr. Raymond E. Ramakis, Regulatory Projects Branch, AVS-24, Safety Regulations Staff, Associate Administrator for Aviation Standards, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591; telephone (202) 755-8716.

SUPPLEMENTARY INFORMATION:

BACKGROUND

This amendment concerning aircraft wheels and wheel-brake assemblies is being issued concurrently with the amendment which updates the minimum performance standards applicable to aircraft tires. The preamble to the tires amendment (published also in this issue of the Federal Register) explains the background which has led to the need for revised standards for tires and for wheels and wheel-brake assemblies and their interrelation.

The accidents and incidents affecting large commercial jet airplanes involving landing gear have resulted in part from failures of tires and of wheels and brakes. With respect to wheels and wheel-brake assemblies, failure due to fatigue is one of the more common and serious types of failures experienced with aircraft wheels. To improve the overall strength of wheels snd to reduce their susceptibility to fatigue, the standards for wheels are being revised. These amendments will require more severe testing of wheels and wheel-brake assemblies to substantiate the load ratings of wheels and the kinetic energy capacity rating of brakes.

These amendments are based on a Notice of Proposed Rule Making, Notice No. 78-16, published in the Federal Register on December 7, 1978 (43 F.R. 57261). That Notice invited comments by all interested persons. All persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented.

Significant comments received in response to Notice 78-16 are discussed below. A number of substantive, editorial, and clarifying changes have been made to the proposed rules based on relevant comments received and on further review within the FAA. Except for minor editorial and clarifying changes and those discussed below, these amendments and the reasons for their adoption are the same as those contained in Notice 78-16.

This amendment implements the President's directive (Executive Order 12044) that regulations be as simple as possible and not impose unnecessary burdens on the economy or on the regulated public. The amendment also promotes the public interest by increasing safety and the efficiency of aircraft through use of improved wheels and wheel-brake assemblies.

DISCUSSION OF GENERAL COMMENTS

Fifteen commenters, including seven non-U.S. organizations, responded to Notice 78-16 with 64 comments. The majority of the comments presented the views of manufacturers and air carriers. In general, the commenters concerned themselves with those areas of the proposal they believe could be improved and raised no objection to the basic concept of the proposal. There were several favorable comments received in support of the proposal and one commenter stated that the proposed revision of the TSO is a significant improvement over the existing TSO.

Two commenters recommended that it should be demonstrated by test that the wheel flanges be able to withstand concentrated loads and not come apart under the condition of deflated or missing tires. There should be a specific test requirement which assures that a wheel will maintain its integrity with the loss of a mated tire. A new paragraph 4.1(c)(3) is added for this purpose.

DISCUSSION OF SPECIFIC COMMENTS

§ *23.735 Brakes*

A commenter suggested the numerical constant in the formula for calculating kinetic energy would be more accurate if written as 0.0443 in place of 0.0442 in § 23.735(a)(2) of the Federal Aviation Regulations (FAR). This change is adopted.

§ *25.735 Brakes*

As pointed out by three commenters, § 25.75, which prescribes landing requirements for reciprocating engine powered transport category airplanes, was deleted by a recent amendment and should no longer be referred to in the rule. The reference to § 25.75 is replaced by a reference to § 25.125 which prescribes the landing requirements for all transport category airplanes.

Two commenters suggested that the numerical constant in the formula for calculating the kinetic energy requirements for each main wheel brake assembly should be 0.0443. The change is incorporated.

Three commenters recommended that "N", as it is used in the formula in § 25.735(f)(2), should be further defined as "the number of wheels with brakes" to be consistent with the TSO. The comment is valid. However, the word "main" must be a part of the definition because § 25.735(f) applies to the brakes on main wheels only. This aspect applies equally to the formula and definition in § 23.735(a)(2). The definitions of "N" in §§ 23.735(a)(2) and 25.735(f)(2) are amended accordingly.

Three commenters recommended that a reference to the accelerate-stop case should be made in § 25.735(f)(2). However, the requirements in that paragraph are for kinetic energy absorption requirements for brake assemblies in normal operations. The provisions for the accelerate-stop distance determination are set forth in §§ 25.105 and 25.109 which concern other performance requirements involved in emergency situations and which are not appropriate for § 25.735(f)(2).

Two commenters suggested that the words "wheel-brake assembly" as they appear in § 25.735(f) and (g) should be changed to "wheel tire and brake assembly." However, tire requirements are covered in § 25.733 and experience has not indicated a need for the recommended change.

§ 37.172 *Aircraft Wheels and Wheel-Brake Assemblies–TSO–C26C*

§ *37.172(b) Marking*

A commenter suggested that the date of manufacture should always be shown in the wheel and brake assemblies. However, no reason was given. The requirement is to mark the serial number or date of manufacture or both. The marking requirements are the minimums necessary for identification of the article by the FAA. If the manufacturer elects to mark the article with the serial number alone, the FAA may obtain the date of manufacture from factory production records when needed. Therefore, it is not necessary that the date of manufacture be shown in all cases in order to adequately identify a wheel or wheel brake assembly.

One commenter recommended that tire change counters be included on the wheel and some external marking be placed on the rim to indicate the position of drive keys to facilitate alignment with rotors on the brake heat sink. While tire change counters and alignment markings may be useful to maintenance personnel, they do not represent a safety consideration and should not be imposed as wheel and brake requirements. The customer may contract with the manufacturer to have these items marked on the wheel if desired.

§ 37.172(c) Data requirements.

A commenter recommended that "stop distance" and "average deceleration" be added as required data and also be added in paragraph 4.2(a)(2) of the TSO where the average deceleration would be defined as equalling the square of the brakes-on velocity (V_{Br}) divided by twice the stop distance(s). As an alternative to adding the stop distance, it was recommended that the stop distance be equal to or less than the square of the brakes-on velocity divided by twice the average deceleration. The TSO establishes the minimum performance required of wheel and brakes. The manufacturer has the option of exceeding the requirements if it wishes. An aircraft or brake manufacturer may use the method recommended but should not be required to do so.

§ 37.172(d) Previously approved equipment.

A commenter recommended a change in the rules to allow a manufacturer to complete its contractual obligations under the TSO requirements in effect at the time of the contract or a 2-year extension beyond the effective date of the new TSO. The problem is the long lead time required to design, build, and test certain types of equipment during which time the TSO may be changed. While this is not unique to wheels and brakes, in some cases a wheel/brake assembly, not yet approved, may be required to meet additional safety provisions contained under the new TSO. However, the rule does not negate any approvals given under the earlier TSO nor does it prohibit production of items under earlier approvals.

This commenter also contended that the new wheel and brake standards will result in increased costs to manufacturers, particularly for transport category airplanes. While some additional costs may be incurred initially because of the extra testing involved, the added safety resulting from fewer wheel failures and less damage to operating aircraft caused by wheel and brake failures will more than outweigh such costs.

Standard for Wheels and Wheel-Brake Assemblies

Paragraph 2(a)(1) Lubricant retainers.

A commenter suggested that the design criteria in the paragraph may be good for wheels but not necessarily applicable for the brake chassis. It contended that if grease retaining is used in the brake chassis, inadequate lubrication results, giving rise to excessive wear and bearing defects. However, there is no service history problem related to lubricant retainers on brake chassis and the commenter offered no supporting data for the suggestion. The paragraph is adopted as proposed.

Paragraph 2.(a)(3) Adjustment.

A commenter recommended that a requirement be added to specify that all brake units be fitted with pressure plate pull-off devices to ensure minimum running clearance when brakes are in the off position. It was asserted that the requirement would assist in reducing heat build-up during taxiing. The commenter did not justify the need for such a requirement. A brake designer is not prohibited from incorporating pressure plate pull-off devices if they are desired. However, no purpose would be served in listing the various brake design features such as pressure plate pull-off devices that may be desirable from an operations or maintenance viewpoint but are not necessary for safety.

Paragraph 2.(a)(5) Explosion prevention.

A commenter suggested that more attention should be given to establishing the correct siting, number, and size of fuses. The commenter also cautioned that provision of too many fuses will increase the risk of running with under-inflated tires. However, the commenter did not recommend any changes or allege that the standard is inadequate. There is no service history to indicate problems with fuse plug selection. The current rule is adequate and is being continued in the new standard. Paragraph 2.(a)(5) is adopted without change.

Paragraph 2.(b) Construction.

A commenter stated that wheel failures are usually associated with fatigue or tire failure. The commenter noted that protection against fatigue failure is not adequately reflected in the standard and suggested that fatigue resistance enhancement measures (such as shot peening, cold rolling, etc.) could be required in fatigue critical areas. As suggested, there should be a specific requirement to improve the fatigue resistance of the wheel and a new section 2.(b)(11) is added for this purpose.

A commenter suggested that heavy emphasis should be placed on standardization with respect to the hub and bead seat areas, and the need for protection of aluminum alloy parts. The commenter asserted that in-service corrosion is a frequent cause of rim failures. Although possible cost benefits to manufacturers and operators may result from standardization of wheel and brake designs, such an option is open without the rules requiring it. Moreover, standardization imposed by the rules could inhibit new designs. With respect to the comments regarding the hub and bead seat areas and protection of aluminum alloy parts, requirements for these areas are adequately covered in paragraphs 2.(b)(1) and 2.(b)(8). No change is made to the proposal based on these comments.

Paragraph 2.(b)(6) Bolts and studs.

A commenter stated that during removal of wheel tie bolts, it has been common experience to find there is insufficient clearance between the socket and wheel surface using standard sockets. Further, if tools are worn, it is necessary to use an inserted protective surface to prevent wheel or brake damage. These comments relate to individual design considerations which may in some cases require special tools. They do not provide a basis for changing the standard.

Paragraph 2.(b)(7) Steel parts.

A commenter recommended that paragraph 2.(b)(7) include words limiting the use of cadmium plating on parts operating [illegible] temperatures above the melting point of cadmium. The comment has merit. Although cadmium and zinc plating have been satisfactory in protecting wheel and brake components against corrosion in the past, the TSO should not limit corrosion protection methods to cadmium and zinc plating. There may be other equivalent or better protection methods, including methods better able to withstand temperature environments. Paragraph 2.(b)(7) is revised to allow other corrosion protection means.

Paragraph 2.(b)(9) Magnesium parts.

A commenter suggested that the use of magnesium alloy parts be avoided in transport category aircraft wheel and wheel-brake assemblies. In the standard, the use of magnesium is optional. The designer may select another material depending on the intended use of the wheel and brake units. If magnesium alloy is used, then it must be given corrosion protection as specified.

Paragraph 2.(b)(10) Bearing and braking surfaces.

A commenter pointed out that paragraph 2.(b)(10) in TSO-C26b was not included in the proposal. The commenter asserted that although finish is not typically applied to assemblies, it is still appropriate to require protection of bearing and braking surfaces if a finish is to be applied. Clearly there is a need for the requirement. The paragraph was inadvertently omitted during the development of the proposal. Paragraph 2.(b)(10) is incorporated in the adopted rule.

Paragraph 3.(a)(2) Rating.

A commenter suggested adding the word "radial" to "maximum limit load" in paragraph 3.(a)(2) to further qualify the meaning of the term. However, the word "radial" refers to direction and would be inappropriate for inclusion under this paragraph since the maximum limit load covers more than just radial loads. Paragraph 3.(a)(2) is adopted as proposed.

Paragraph 4.1 Wheel tests.

A commenter recommended the test inflation pressure be increased up to a factor of 3.5 in place of the factor of 2 to avoid bottoming the tire while under the ultimate test load in paragraphs 4.1(a)(3) and 4.1(b)(3). The commenter contended that aircraft tires are operationally subject to test overpressures of 4 and 4.5 times their rated inflation pressure. The purpose of the ultimate load test is to load the wheel in a manner which is indicative of in-service conditions. Increasing the tire inflation pressure would provide an incorrect distribution of load on the wheel. Under the proposal, when tire bottoming occurs due to the application of ultimate test loads, provision is made for use of a loading block which fits between the rim flanges and simulates the load transfer of the tire. This test arrangement is satisfactory for determining yield and ultimate strengths of the wheel. No change is made based on this comment.

Another commenter objected to allowing the tire pressure to be increased up to 2 times the rated inflation pressure to avoid tire bottoming during the ultimate load tests in paragraphs 4.1(a)(3) and 4.1(b)(3). It was claimed that the test pressure allowed eliminates the only test condition that tests wheel flanges under concentrated loads. The commenter asserted that concentrated loads on the wheel flanges may occur when the wheel is rolling while the tire is deflated or missing. Finally, the commenter suggested that if the proposed test pressure is allowed, a separate test should be devised that demonstrates wheel flange strength. As previously discussed under General Comments there is sufficient justification to require a demonstration of flange strength based upon a missing tire, and a separate test is added under paragraph 4.1(c)(3). No other changes to paragraph 4.1(a)(3) or (b)(3) are necessary.

A commenter contended that recent experience indicates there is a need for wheel tests with the brake unit installed. It was suggested that such tests be conducted under the test loads specified in proposed paragraph 4.1. In addition, the commenter recommended the tests include checks for adequate clearances between the wheel drive keys and brake rotor assembly while under test loading conditions. The commenter did not identify the experience and FAA records do not indicate any such problems in connection with past approvals of wheel and brake assemblies. Paragraph 4.1(a) is adopted without change.

A commenter suggested that the ultimate test in paragraph 4.1(b)(3) be done with side loads applied in the most critical direction. However, such detailed specification is unnecessary since the direction, including inboard and outboard side directions, and magnitude of the test loads are established in accordance with the FAR sections referenced in the standard.

A commenter pointed out that the use of the loading block specified in paragraph 4.1(b)(3) is incompatible with the statement in paragraph 4.1(b)(1). For clarification, the words "or the loading block" are added immediately after the word "tire" in the eighth sentence of paragraph 4.1(b)(1). Another commenter wanted the fit and loading position of the loading block to be more clearly defined. However, the paragraph prescribes the length of arc, the width and fit, and the transfer characteristics of the block and therefore provides adequate information for use of the loading block.

A commenter contended that the yaw roll test of paragraph 4.1(c)(2 should be conducted with radial and side load components resulting from a 0.15g turn of the aircraft at the maximum weight and most adverse center of gravity location, as determined by the airframe manufacturer. Although the values of 0.15S and 0.15g are numerically equal, the side load component is more clearly defined as 0.15S rather than specifying a 0.15g turn condition as suggested by the commenter. Moreover, the maximum static load (S) is defined in terms of design takeoff weight and critical center of gravity as provided in § 25.731(b), which is referenced in paragraph 3.(a)(1). Another commenter understood that the intent of the proposed yaw roll test is to simulate a 0.15g turn condition and noted that the side load component is described as 0.15S in which S is a static load. The commenter did not distinguish the relationship of the terms 0.15g and 0.15S. There is no reason for wheel and brake manufacturers to have difficulty in interpreting the meaning of 0.15S since the ground loads section of Part 25 designates side loads in terms of vertical ground reactions. No change is made based on these comments.

A commenter suggested that "radial load" be changed to "vertical load" in paragraph 4.1(c). It is asserted that a vertical load would be perpendicular to the loading surface, whereas a radial load will have the same angular orientation as the wheel. However, in normal testing the orientation of the test wheel with respect to the loading surfaces may be such that applied loads are horizontal. In addition, the language is clear in the standard in requiring the radial load to be applied to the wheel through the axle and perpendicular to the load surface. The term "radial load", therefore, accurately expresses the intent.

A commenter suggested that it should be made clear what rotational speed of the wheel is required in the roll test. Its experience is said to indicate that a good speed is about 10 miles per hour. However, the commenter did not provide any information to show that the standards should include a specified wheel test speed. Actually, although the roll performance of the wheel is not affected by roll speed, the roll speed must be selected to accommodate the operating characteristics of the installed tire. Under the proposal, the intent is that the applicant select any speed consistent with the tire characteristics.

A commenter recommended that the wheel roll tests should include an overload test requirement. It was pointed out that in light of the 1.5 overload test factor for tires, wheel test criteria should at least match this requirement. It was alleged that wheels can be subjected to twice their normal rated load on more than one occasion during their service life. In this connection, however, significant improvements in wheel testing are being made in this standard over the wheel tests in the previous TSO and provide the equivalent of the overload test suggested by the commenter. An overload test for wheels is therefore not needed.

A commenter pointed out that since a 7 percent safety margin was introduced for tires on transport category airplanes, it is advisable to include a 7 percent strength margin for wheels. It was suggested that one method of accomplishment would be to revise the overpressure factor from "4.0" to "4.07" in paragraph 4.1(d)(1). The comment, however, does not take into account that the overpressure factor for wheels is being increased 14 percent under paragraph 4.1(d)(1) which more than compensates for the 7 percent load margin applied to main dual wheel tires. The comment offers no justification for increasing the overpressure factor above 14 percent. This increased factor, being adopted as proposed, provides the necessary strength margin.

One commenter objected to the 4.0 overpressure factor in paragraph 4.1(d)(1), contending that the reasoning behind the increase from 3.5 to 4.0 was not understood. It was claimed that overinflation in service of this magnitude was highly unlikely and the 3.5 factor seemed acceptable. In recent years some air carriers have been operating with higher tire inflation pressures resulting in fewer tire-wheel-brake failures due to lower operating temperatures. The continued operation at higher inflation pressures requires stronger wheels to maintain their normal life expectancy. In addition, tire standards now include a higher overpressure factor (4.0) requirement for all types of tires. Thus, a compatible overpressure test for wheels is needed to establish a level of safety consistent with that of tires. No change is made based on this comment.

Two commenters supported the proposed 4.0 overpressure factor. One stated that the overpressure factor 4.0 should improve the strength of wheels. The other suggested that under conditions of high heat transfer, it should be demonstrated that the wheel is able to dissipate its pressure down to a residual level which will not cause bursting if wheel strength is impeded. However, such a requirement would inhibit design. The wheel and brake designer must account for critically high temperatures and pressures that may occur by installing adequate temperature and pressure-sensitive relief devices.

Two commenters objected to the 5 percent maximum pressure drop from rated inflation pressure in a 24-hour period in the diffusion test requirement of paragraph 4.1(d)(2). They suggested the 5 percent be lowered and one recommended specifically that it be revised to 3 percent. The other supported the need for an overall leakage factor no greater than 5 percent and noted correctly that since the tire alone is allowed 5 percent, the leakage factor for the wheel would then have to be zero percent. The standard provides that the tire-wheel combination be subjected to the diffusion test for which the 5 percent pressure drop limit provides the required level of safety. The recommendation for a change to 3 percent was unsupported and the commenter provided no basis for going to a stricter limit. Therefore, no change is made based on these comments.

Paragraph 4.2 Wheel-brake assembly tests.

Where a wheel, as part of a wheel-brake assembly, has previously been tested at a relatively high kinetic energy level, one commenter recommended that when a different brake of lower kinetic energy is to be later used with the same wheel, only the brake should be required to be tested. The test is suggested, according to the commenter, because a given wheel model may be fitted with many brake assembly models. However, the test procedures recommended would not be in accord with § 25.735(f) and proposed paragraph 4.2 which require wheel and brake units to be tested as assemblies. Under the commenter's proposal, the functional compatibility of the wheel and brake would be unknown since they would not have been tested as a unit. Therefore, no change is made to paragraph 4.2 based on this comment.

A commenter noted that paragraph 4.2 does not appear to require any kinetic energy margin to be built into the brake. That is correct; it is not necessary to require a specific safety margin if it can be demonstrated that the brakes are adequate for the purpose intended and can operate safely.

The commenter also noted that the proposed tests allow credit for all brakes on an aircraft when there have been cases during rejected takeoffs where one or more tires have blown thereby rendering the corresponding brakes ineffective. However, the rationale is that wheels and brakes should not be unduly penalized by requiring over-design because tires may fail in operation. As pointed out previously, the FAA is upgrading aircraft tire standards to strengthen tires which will result in safer tire-wheel-brake combinations for the future. No change is made based on the comment.

Three commenters suggested that the word "tyre" be included in the term "wheel-brake assembly" in the proposed paragraph 4.2. It was stated that adding the word "tyre" would avoid the use of a test tire which might absorb more than the correct share of kinetic energy. As suggested, the requirement should be clarified and the paragraph has been changed to specify inclusion of a suitable tire of proper fit.

These commenters also recommended that the word "torque" be deleted from the title "Dynamic torque tests" in paragraph 4.2(a). However, the word is appropriately used in the standard since the intent is to measure torque accurately.

These commenters further contended that where the energy absorbed by the tire can be satisfactorily established, an allowance for this should be made. However, this would effectively reduce the required kinetic energy ratings for wheel-brake assemblies and would be contrary to current safety needs to upgrade wheel and brake units.

These commenters also asserted that the last sentence in paragraph 4.2(a)(1)(ii) about not considering decelerating effects of certain equipment is inconsistent with § 25.125(b)(3). To the contrary, however, the language in the standard clarifies the test conditions by identifying those items whose decelerating effects are disallowed. Moreover, allowance of the prescribed deceleration effects in the qualification tests would reduce brake energy capacity ratings and would be contrary to the intent of the standard to upgrade wheel and brake standards.

Two commenters pointed out that Method II in paragraph 4.2(a)(1)(ii) is allowed only for landing and recommended that it also be allowed for the accelerate-stop case. The first sentence of paragraph 4.2(a)(1)(ii) is amended accordingly.

Paragraph 4.2(a)(2) Test requirements.

Two commenters suggested that the deceleration rated specified in Table II in paragraph 4.2(a)(2) be defined as equalling $V^2/2S$, where V equals brakes-on velocity and S equals the stop distance. They claimed that stop distance is the key parameter in determining acceptability of the test results and that deceleration rate based on "time" will not necessarily result in an acceptable test. The comment is not accepted since the stop distance will vary between airplanes and can be established from the rate of deceleration as appropriate.

A commenter recommended that for the products already approved by TSO–C26b, only 100 design landing stops should be required for the brake assembly, without the wheel, for

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certification under TSO-C26c. However, as discussed earlier in connection with kinetic energy considerations, a wheel and brake must be tested together to assure compatibility of performance.

Four commenters recommended that the accelerate-stop test required in paragraph 4.2(a)(2) of the standard be conducted with brakes approaching the fully worn state. They maintain that the wearing elements of the brake assembly may be worn to a condition in which they are no longer capable of absorbing the maximum kinetic energy expected in service such as an accelerate-stop condition. However, in-service maintenance records do not indicate that there are failures associated with worn brakes not meeting rejected takeoff energy levels. Moreover, wear indicators on the brakes and required maintenance checks assure that brakes are replaced prior to the point at which they are no longer capable of absorbing the maximum kinetic energy. The commenters presented no evidence substantiating a need for such a test.

A commenter suggested that the accelerate-stop deceleration rate in Table II selected by the manufacturer should be required to be equal to or greater than the deceleration required to produce the performance published in the Aircraft Flight Manual (AFM). However, no basis has been presented to relate requirements in the standard with the AFM as suggested by the commenter. The deceleration values used in certifying wheel-brake assemblies are selected by the manufacturer to obtain an estimated braking capability. The information in the AFM is related to actual aircraft flight test data.

A commenter recommended that for the sake of safety, the accelerate-stop requirement in proposed Table II should be applicable to all aircraft. However, it is not practical to determine an accelerate-stop distance for a single-engine airplane or any rotorcraft. Paragraph 4.2(a)(2) is adopted without change.

Paragraph 4.2(a)(3) General conditions.

One commenter suggested that the following sentence be added to paragraph 4.2(a)(3)(ii): "Towards the end of the accelerate-stop test (KE_{RT}), it is permissible to release the brake when the inertia testing machine speed has reduced to not more than 10 knots." It claimed that for some brakes where the value of KE_{RT} is particularly high, it is possible for the friction elements to seize up at the end of the accelerate-stop thus preventing the brake from being usable for taxi. The suggestion would not be in accord with § 25.109 which requires the airplane to come to a full stop during the accelerate-stop test.

A commenter suggested that the requirement for the brake to be usable for taxi after the accelerate-stop test be qualified by specifying taxi distance, taxi speed, and the number of additional brake applications expected following the deceleration. In view of present service experience there is no safety basis for requiring a brake to be usable after an accelerate-stop test. Accelerate-stop performance is currently predicated upon a condition of nonusable brakes and the allowance for subsequent maintenance prior to the removal of the airplane from the runway. Accordingly, paragraph 4.2(a)(3) is adopted as proposed.

Paragraph 4.2(d) Endurance tests—hydraulic brakes.

A commenter pointed out that no consideration is given to the size of the brake equipment in the 5cc maximum leakage test in the standard. It asserted that since leakage varies with the size of the equipment, the 5cc limit appears to unjustly penalize large systems. This commenter recommended the proposed leakage rate be revised by allowing one drop per 25 cycles per 3-inch seal periphery. Another commenter asserted that it would consider its smallest brake a failure if it leaked 5cc. On the other hand, it was claimed that if its largest brake were to leak 5cc, it would consider the leakage minimal. This commenter suggested military standards be adopted, which in effect specify that after 25 cycles, (1) leakage at static seals not exceed a trace, and (2) leakage at moving seals not exceed one drop of fluid per each 3 inches of peripheral seal length. Although several methods of leakage measurements are available, the volumetric approach proposed in the notice gives a uniform standard and 5cc is acceptable for all sizes. Moreover, with reference to using words "trace" and "drop" as in the military standard, such terms do not define an identifiable and enforceable standard. The paragraph is adopted as proposed.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 23, 25, and 37 of the Federal Aviation Regulations (14 CFR Parts 23, 25, and 37) are amended as follows, effective December 31, 1979.

(Secs. 313(a), 601, and 603, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421, and 1423); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).)

Note: The FAA has determined that this document involves a regulation which is not considered significant under Executive Order 12044, as implemented by DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained from the person listed under the heading "FOR FURTHER INFORMATION CONTACT" set forth earlier in this document.

Amendment 25-49

Aircraft Tires

Adopted: November 21, 1979 **Effective: December 31, 1979**

(Published in 44 FR 68745, November 29, 1979)

SUMMARY: The purpose of these amendments is to incorporate updated and improved minimum performance standards applicable to main landing gear and nose wheel aircraft tires, and more comprehensive transport category airplane type design standards covering tire loads and speed ratings. These revisions are necessary in the interest of safety to meet increasingly severe tire operating conditions. The amendment for tire standards specifies a cutoff date after which tire manufacturers can no longer identify certain high-speed tires as approved under earlier standards.

FOR FURTHER INFORMATION CONTACT:

Mr. Raymond E. Ramakis, Regulatory Projects Branch, AVS-24, Safety Regulations Staff, Associate Administrator for Aviation Standards, Federal Aviation Administration, 800 Independence Ave., S.W., Washington, D.C. 20591; telephone (202) 755-8716.

SUPPLEMENTARY INFORMATION:

BACKGROUND

During recent years, there has been a series of accidents and incidents involving large commercial jet airplanes, particularly wide-body types, that involved failures of tires, wheels, brakes, and anti-skid devices. Some of these events resulted in complete destruction of three airplanes and in injuries and fatalities to occupants.

Beginning in 1975, the FAA placed strong emphasis on intensifying its ongoing safety surveillance efforts with respect to aircraft tires and began an analysis of tire failures and potential corrective actions. The FAA determined that complex landing gear systems, unprecedented high maximum aircraft operating weights, and the operation of all aircraft at higher taxi speeds over long taxi distances were among the significant factors in the tire failures.

As a result of its evaluation, the FAA developed tentative changes to the standards for both tires and wheel-brake assemblies. These efforts led to joint FAA-industry meetings in 1976 and 1977 during which the proposed standards were further revised and updated to reflect the latest technology and to meet operating conditions. Notice No. 78-16 (43 FR 57261; December 7, 1978) was issued to upgrade standards for aircraft wheels and wheel-brake assemblies and a final rule on that subject is published in this issue of the Federal Register. With respect to tires, on March 9, 1979, the FAA issued Notice No. 79-7 (44 FR 16430; March 19, 1979), which proposed regulatory changes directed at upgrading and improving the minimum performance standards applicable to main and nose wheel aircraft tires (§ 37.167 Aircraft Tires—TSO-C62b), and more comprehensive transport category airplane type design standards covering tire loads and speed ratings (§ 25.733). That Notice also proposed that all tires approved under the TSO procedures and manufactured after a specified future date meet the new standards.

This rulemaking action is one of a number of related steps in a program to resolve the tire problem. Though not part of this rulemaking action, the FAA has taken or has under consideration other actions intended to improve tire maintenance practices and to update requirements for tires installed on airplanes currently in service. Advisory Circular No. 20-97, High Speed Tire Maintenance and Operational Practices, dated 1/28/77, and Maintenance Bulletin 32-3, (1/28/77) provide guidance material to assist the operating personnel concerned with tire maintenance. In the regulatory area, the FAA, in this issue of the Federal Register, is proposing an operating rule that would require certain airplanes to be equipped with tires meeting the new TSO standards by specified future dates.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. The more significant comments received in response to Notice 79-7 are discussed below. A number of substantive, editorial, and clarifying changes have been made to the proposed rules based on relevant comments received and on further review within the FAA. Except for minor editorial and clarifying changes and the changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notice 79-7.

These amendments implement the President's directive (Executive Order 12044) that regulations be as simple as possible and not impose unnecessary burdens on the economy or on the regulated public. They also are designed to promote the public interest by increasing safety and the efficiency of aircraft through use of improved equipment.

DISCUSSION OF COMMENTS

Thirty-three individual sets of public comments were submitted in response to Notice 79-7. Many of the commenters submitted multiple lengthy recommendations. While the great majority of the commenters were in general agreement with the objectives of the proposals, a number of them suggested changes, requested clarification or guidance, and offered specific criticisms. Other commenters proposed changes that are beyond the scope of this rule making and they are not discussed here.

§ 25.733

Several commenters questioned the requirements in proposed § 25.733. Under proposed § 25.733(a), one commenter stated that the operational inflation pressure rating associated with the load rating should be provided. This is not practicable as these pressures, prescribed by the airframe manufacturer, will vary depending upon the maximum operating gross weight of the airplane. Another commenter recommended a clarification of paragraph (a)(1) to include consideration of the most critical combination of loads up to maximum ramp weight and deletion of engine thrust and inertial effects. The commenter pointed out that because of variations in the position of the airplane center of gravity, the highest tire load condition is not always at maximum ramp weight of the airplane and that engine thrust and inertial effects are minor and should be considered under the proposed 7 percent load factor. Clearly, the most critical combination of airplane center of gravity and airplane weight (up to maximum ramp weight) should be considered in the establishment of the maximum load rating of the tire. However, the engine thrust and inertia effects should not be excluded from this established rating since, while these effects are minor, the 7 percent is intended to cover other unequal load conditions. Finally, in response to two other comments, paragraphs (a)(1) and (a)(2) are clarified with respect to the application of a single tire installation. With the changes noted, § 25.733(a) is adopted as proposed.

Under proposed § 25.733(b), one commenter suggested that paragraphs (b)(1), (b)(2), and (b)(3) be changed to reflect the critical airplane maximum weight, up to the maximum ramp weight and landing weight, as applicable. For the reasons discussed under paragraph (a), the most critical combination of airplane center of gravity and airplane maximum weight up to maximum ramp or maximum landing weight, as applicable, should be assessed in determining the tire load rating. One commenter suggested that the ability of a nose wheel tire to sustain an increased load by a factor of 1.5 in paragraph (b)(2) and (b)(3) be demonstrated while another commenter under paragraph (b)(3) recommended terminology change from "wheel" to "wheel-tires". However, service experience does not warrant imposing the burden of demonstrating the designed 1.5 nose wheel load factor and no justification was given for changing "wheels" to "wheel-tires". Section 25.733(b) is adopted as proposed with the changes noted.

Under proposed § 25.733(c), one commenter pointed out that paragraphs (c)(1) and (c)(2) would be meaningless unless a statement concerning an increase in tire inflation pressure (due to the 1.07 factor) was included. Since the proposed 7 percent load factor in paragraph (c)(1) can only be maintained with a corresponding increase in inflation pressure, a provision for required inflation pressure necessary to assure the application of this derating factor is therefore included in the proposed operating rule published in this issue of the Federal Register. Although another commenter suggested clarifying the term "axle" with respect to additional configurations, the description of the landing gear axle is sufficiently clear to accommodate all multiple main wheel tire configurations. Two commenters stated that paragraph (c)(2) should include a reference to paragraph (b)(3) for nose wheel tires. One of the commenters also suggested that the word "tire" be added and that the paragraph include the 1.07 factor. In addition, one commenter questioned the absence of the 1.5 factor as proposed in paragraph (b). For clarity, paragraph (c)(2) should contain the paragraph reference (b)(3) and the additional word "tire" at the end of the paragraph. However, service experience does not warrant application of the 7 percent load factor to nose wheel tires. The 1.5 factor is not appropriate to main wheel tires since it is applied only to the nose wheel tire on the basis of additional takeoff and landing loads. Proposed § 25.733(c), (c)(1), and (c)(2) are adopted with the changes noted.

Recommended changes to proposed § 25.733(d) included a provision for allowing intentional tire contact from items such as rub strips, spin brakes, and guide rails. Another recommendation concerned the need to specify tire clearance on the basis of dynamic growth conditions. Paragraph (d) is revised to provide for intentionally designed contact as suggested. However, any other contact, considering both static and dynamic conditions, would not be allowed under this paragraph. One commenter stated that paragraph (d) should also apply to nonretractable landing gear systems. However, because of the different factors involved, the FAA will consider whether requirements for nonretractable gear may be necessary in future rulemaking actions.

Finally, a new paragraph was recommended by one commenter to provide that failure of any one tire on multiple wheel aircraft during takeoff, rejected takeoff, or landing should not cause hazardous loss of braking or directional control of the airplane. The objective of § 25.733, as well as that of § 25.735, is to preclude the hazardous loss of braking and airplane directional control due to system failure. The upgraded standard here being adopted is directed at reducing single and multiple tire failures. Since the revision will accomplish this objective, the recommended change is not necessary.

§ 37.167 Aircraft Tires—TSO-C62c

No substantive comments were received on the applicability provisions in § 37.167(a) and it is adopted as proposed.

With respect to the marking requirement under proposed § 37.167(b), one commenter recommended in paragraph (b)(1) that the "brand name" be deleted as the manufacturer's name was considered sufficient. Another commenter recommended that, to be useful, the qualification test date or date of manufacture should be included. The deletion of brand name in lieu of manufacturer name is not appropriate, since a manufacturer may produce multiple brands. The need for dates is not justified since a qualification test date is already contained under approval records, and the date of manufacture can be readily obtained from the tire serial number. Under paragraph (b)(2), a commenter suggested adding the phrase "over 120 mph" after speed rating and adding "ply rating" in lieu of "load rating" since it is recognized by all standardization bodies. The same commenter suggested the deletion of "skid depth" and "manufacturer part number" as not being necessary. The load rating should not be eliminated since, like the speed rating, it identifies the maximum operating load condition the tire should not exceed. The speed rating marking for a tire operating at 120 mph and below should not be deleted for the same reason. Contrary to the commenter's assertion, the skid depth and manufacturer's part number are required because they identify a given design and the characteristics of a given design which may affect tire performance. There is nothing to preclude a ply rating marking on a tire if desired by the tire manufacturer. Section 37.167(b) is adopted as proposed.

Proposed § 37.167(c) sets forth data requirements. One commenter recommended that the word "mold" be added before "skid depth" in proposed § 37.167(c)(1) because the mold skid-depth can be controlled. The requirement has been changed accordingly. Under the same paragraph one commenter suggested the addition of nominal and actual load radius, including tolerances, at rated load and inflation pressure. Another commenter suggested the submission of load-deflection curves or test results. To ensure completeness of data, it is appropriate to add nominal and actual tire loaded radii including tolerances at rated load and inflation pressure. The submission of load deflection information is necessary to assure compatibility between tires installed on an aircraft. Proposed § 37.167(c)(1) is revised accordingly.

Section 37.167(c)(2) would require the tire manufacturer to furnish applicable maintenance and repair instructions. One commenter suggested that the tire manufacturer consult with the aircraft manufacturer to ensure necessary input to the instructions. Three other commenters objected outright to the proposal. One stated that this would imply mandatory use of that information by an operator or retread agency, both of whom are certificated by the FAA. Another suggested that recapping or retreading procedures should be in a separate document and not mixed in with new tire requirements. The third commenter suggested the deletion of the entire paragraph on the ground that retreading of aircraft tires is not a repair. According to the last commenter, the fact that retreaders use different materials, different numbers of reinforcing plies, different shaped molds, different tread patterns, different skid depth, etc., results in a product (retread) that is not a repaired new tire but a new product, one ingredient of which is a used carcass. On this basis it was suggested that a Technical Standard Order (TSO) governing the performance standards required for a retread should be issued. According to the commenter, this could be very similar to the new tire TSO and require virtually all of the certification required of a new tire.

Requiring a manufacturer to supply the information outlined in § 37.167(c)(2) is consistent with other regulations, such as §§ 23.1529, 25.1529, 27.1529, and 33.5, that require manufacturers to supply maintenance and inspection information with their products. The reason the criteria were outlined in the proposal was to identify specific maintenance and inspection information that a manufacturer must provide with its product. This information is intended to be made available to persons who maintain tires. It is not considered necessary that such information be the result of consultation with the airframe manufacturer. There are widely varying types of operations in the airlines and wide variation in airlines' capability to develop tire maintenance and inspection data. Not all users and repair facilities have this capability and of necessity must rely on data developed by the manufacturer as a basis to maintain and inspect tires. To require a new tire to be built under one TSO and then maintained under a separate TSO is impractical. Under the maintenance performance rules of § 43.13(a) and (b), a product after undergoing maintenance shall be at least equal to its original or properly altered condition. This makes it necessary for a tire on which maintenance was performed to continue to meet the requirements outlined in the TSO under which it was built. However, if a tire undergoing repair were altered, it would be considered a new product and it would be necessary for the tire to be tested for approval under the TSO and be approved for use on each aircraft of which it would be a part. Section 37.167(c)(2) is therefore adopted as proposed.

Section 37.167(d) proposed a two-year cutoff date after which all newly manufactured tires could no longer be identified as approved under earlier tire standards. One set of commenters recommended the exclusion of low-speed tires on the basis that retesting and related costs are not supported by adverse service experience. They contended that low-speed tires should be requalified only when the new ratings differ from those ratings on tires previously approved. Another group commenting on high speed tires recommended that the 2-year cutoff date be deleted, stating that the new TSO requirements should be applied to existing aircraft only on a case-by-case basis as supported by tire service history data. They further indicated that installing new and heavier tires on existing aircraft would require further analysis and flight tests to assure that the aircraft and systems would not be adversely affected. Several commenters of this group recommended extending the cutoff date to periods up to 5 years because of the limited dynamometer capacity available, costs, and possible tire shortages. One of the commenters pointed out that tires which the FAA wants to have qualified in a shorter time could be accomplished through the issuance of a proposed operating rule. Finally, two commenters questioned the application of the proposal to all tires when the preamble noted implementation of an operating rule affecting only certain aircraft.

Information contained in the many comments received in response to § 37.167(d) indicates that the proposed 2-year cutoff date for manufacturing of all tires to the old standards is too restrictive. Specifically, it would have a significant and adverse impact on the manufacture of low-speed tires which do not share the same failure history as reported on high-speed tires. Based upon a review of service experience, which for low-speed tires has been good, and after further consideration, the FAA has determined that low-speed tires need not be requalified and should be excluded from the proposed cutoff requirements. This exclusion applies to all presently approved tires rated at speeds up to 160 mph.

In this issue of the Federal Register [44 FR 68759, 11/29/79] the FAA is proposing an operational requirement for retrofit installation by certain rates of new high-speed tires (above 160 mph) on certain transport category airplanes whose tire problems and hazards are more clearly identified. That action, however, does not preclude the need to phase out the manufacture of tires approved under older standards for use on other aircraft operating at high gross weights or speeds or both. With respect to high-speed tires (rated over 160 mph), several commenters recommended extending the proposed 2-year cutoff date for manufacture under older standards. In their view, the 2-year date is too early and they specifically recommended that 3 years would be more realistic. The commenters pointed out that the cutoff must be consistent with availability of tires meeting the new standard. The controlling factors for this availability are the limited number of dynamometers industry-wide that can be used to test each tire model and the time required to redesign, retest, and then manufacture the large number of tire models involved. These and related factors, which are discussed in detail in the preamble of the notice published in this issue of the Federal Register, are used in arriving at dates by which certain transport category airplanes can be retrofitted with tires meeting the new standard. Based on the comments and data submitted, and upon reconsideration of the matter, the FAA has determined that discontinuance of manufacture of older high-speed tires by a date 3 years after the effective date of the new TSO standard is consistent with the development and manufacture of tires to the new standard to provide the necessary improvement in safety. This cutoff date will impose no undue economic burden in tire manufacturers or operators since it will provide adequate time for development of newly designed tires yet permit manufacture of older design tires to the extent necessary to assure an adequate supply pending completion of retrofit.

STANDARD FOR AIRCRAFT TIRES

Section 1.0 Purpose.

Two commenters recommended that the proposed new standard be limited to tires for transport category airplanes and that Part 27 and Part 29 rotorcraft tires be excluded. One of the commenters contended that the proposed changes result from service experience on wide-bodied jet airplanes, and that they were unaware of comparable service experience on rotorcraft of any size or category. Another commenter stated similar reasons for excluding tires for Part 23 aircraft and suggested the establishment of two standards. The standards should not be limited to large aircraft since the requirements in the standard take into account the variation in tire performance as characterized by small and large aircraft. Moreover, as previously discussed, low-speed tires approved to older standards may continue to be manufactured under the terms of their original approval. Paragraph 1.0 is adopted as proposed.

Section 2.0 Scope.

One commenter recommended the inclusion of "inflation pressure" in connection with the load rating. While a rated inflation pressure must be established to provide for the design load rating of the tire, such information will be obtained by the FAA under the proposed data requirements in § 37.167(c). Therefore, there is no basis for including inflation pressure also under paragraph 2.0. Paragraph 2.0 is adopted as proposed.

Section 3.0 Material requirement.

One commenter recommended that the requirement also address processes which could equally affect performance. Another commenter pointed out the difference of materials between small and large aircraft tires and suggested that the suitability of materials should be predicated upon a substantiated service experience involving a tire of similar size and speed rating. The requirement is directed to the suitability of materials and the comments do not justify expanding the requirement to cover processes or explain why service experience should be limited in the narrow way suggested. Paragraph 3.0 is adopted as proposed.

Section 4.0 Design and construction.

No comments were received on individual requirements relating to unbalance, balance marker, and overpressure, paragraphs 4.1, 4.2, and 4.3, and they are adopted as proposed.

In proposed paragraph 4.4.1 of the standard relating to ambient temperature, several commenters objected to the optional use of analysis since it was claimed no analysis method is known. Another commenter recommended that the paragraph be deleted or changed to read: "... shown by analysis that the physical properties of the tire materials have not been degraded by exposure of the tire to...." That commenter pointed out that the recommended change would allow tire sample tests in lieu of requiring the use of facilities for full-scale tests which are not available. Another commenter questioned the severity of the proposed test temperatures and duration and questioned whether it would prohibit operations on aircraft cleared at lesser temperatures. In response to these comments, an optional analysis method should be allowed since an analysis method may exist or might be developed. The proposed tests need not nor were they intended to involve the performance of a full-scale tire. Therefore, the recommended change for applicable tests or analysis to substantiate the physical properties of the tire materials is adopted. Based on service experience, the 24-hour test period is not overly severe and the actual operational tire temperatures are consistent with those prescribed. Finally, although questioned by one commenter, the temperature limits specified are clearly stated.

In proposed paragraph 4.4.2 of the standard, concerning wheel rim heat, one commenter questioned the basis for the prescribed temperature and duration, while two other commenters objected to the application of the 300°F wheel bead seat temperature to nose wheel tires and low-speed tires. They suggested that paragraph 4.4.2 apply only to high-speed tires or that, in the case of nose wheel tires, they be identified for non-use on wheels subjected to operational temperatures in excess of 250°F. Not all aircraft tires operate within the proposed temperature environment and exposure period. To accommodate different tire designs which, by application, are not to be operated near the prescribed 300°F temperature, paragraph 4.4.2 is revised to allow low-speed tires or nose-wheel tires to be tested or analyzed at other highest wheel bead seat temperatures expected to be encountered during normal operations. Although questioned by one commenter, the provisions for an optional analysis method is retained for the reasons previously discussed in connection with ambient temperature. For consistency with paragraph 4.4.1 the requirement has been reworded to require that the physical properties of the tire materials not be degraded by exposure to the specified conditions.

Two commenters suggested wording changes to paragraph 4.5 concerning tread design, but these were not substantively justified or indicated as necessary for clarity. The paragraph is adopted as proposed.

Under paragraph 4.6, Slippage, one commenter questioned the basis for not allowing slippage within the first five cycles. The prescribed five dynamometer cycles have been an accepted industry practice to assure that the tire is properly fitted to the wheel during and prior to the initiation of tests. Experience obtained from past testing indicates that a period of five landing cycles is satisfactory. Paragraph 4.6 is adopted as proposed.

Considering it to be a necessary requirement, one commenter recommended addition of a new paragraph 4.7 covering an air leakage test. The recommended leakage test is an essential performance requirement and, since it is consistent with the current industry practice and will not result in any undue burden, the recommendation is adopted as new paragraph 4.7.

Section 5.0 Ratings.

Under paragraph 5.1, load ratings, two commenters recommended a change to provide that tires of proper load ratings be selected in accordance with the applicable FAR, but that the ratings for selection be established by a recognized industry standardization body or by the Administrator. The applicant should have the right to select or establish a tire load rating as long as it is in compliance with the applicable FAR sections. As provided under § 25.733, the Administrator approves the load rating once established. The recommendations which would provide that some third-party organization establish the tire load rating is, therefore, not accepted.

One commenter recommended that the manufacturer be required to make tire deflection information available to assure compatibility of tires on the same axle while two other commenters recommended that the deflection provision be deleted since it is not part of the load rating or required under the TSO. To eliminate the confusion between "tire deflection" and "percent deflection" one of the commenters recommended the addition of a new paragraph and term "loaded radius" which is defined as the distance between the axle centerline and the operating surface of a loaded tire. The commenter also recommended that the tire load rating be established by the tire manufacturer and approved by the Administrator. Another commenter suggested changing the second sentence to identify tire deflection at loads up to 1.5 times the rated load and rated inflation pressure.

Under the standard a tire need not be designed to any specific load-deflection criterion. However, it is necessary that a tire's deflection characteristics at various loads and inflation pressures be identified to assure that a given tire design is compatible with another tire during its installation on an aircraft. In this issue of the Federal Register, the FAA is proposing as part of a new operating rule that the deflection between two tires mounted on a single axle be within acceptable limits at various operational loads up to maximum rated loads. The identified deflection information, which will form the basis for this acceptance, is required under § 37.167(c). Deflection at higher loads up to 1.5 times rated load must be included under this information. The description of tire deflection in terms of "percent deflection" can be deleted in view of a more appropriate "loaded radius"definition. Since, as provided under § 37.167(c), the manufacturer or TSO applicant must furnish the tire load rating, there is no basis for also referencing the tire manufacturer under paragraph 5.1. Therefore, the identification of a more appropriate loaded radius criterion is provided under a new paragraph 5.3 and § 37.167(c). Paragraph 5.1 is revised accordingly by deleting the sentences pertaining to percent deflections and radial distance.

Under paragraph 5.2, Rated inflation pressure, one commenter suggested a change to specify that the inflation pressure would be established by the tire manufacturer and approved by the Administrator. However, in view of the data requirements of § 37.167(c), there appears no need to further reference the manufacturer in paragraph 5.2. Two commenters recommended changing the ambient temperature to 68°F or to the extreme limits specified in paragraph 4.4.1 and identifying the rated inflation pressure under no load. The view to define the rated inflation pressure under either a rated load or no load was also shared by another commenter. In connection with these comments, a specific ambient or extreme temperature should not be specified since design temperatures differ among manufacturers. The recommendation to establish rated inflation pressure at extreme operating temperatures was unsupported. However, there is merit in the suggestion that the temperature on which a manufacturer bases a tire load and pressure rating should be identified. This is necessary to clarify the rated inflation pressure which, in accordance with long standing operating practice, is based upon a no load condition. Paragraph 5.2 is revised accordingly.

Section 6.0 Dynamometer test requirements.

One commenter suggested that since tire deterioration is not necessarily visible, the paragraph should state "... without significant deterioration of the carcass, tread, or inflation pressure. ..." A commenter also recommended that lack of such deterioration be verified by test. Another commenter recommended that since tread damage is permitted in the overload test, the paragraph should be changed to read "... other than normal expected wear except as noted in paragraph 6.3.3.3." Inclusion of the word "significant" would not result in a more specific requirement. Neither has sufficient justification been shown to require further test verification in view of the new acceptance criteria established under paragraph 6.3.3.3 for the single tire test specimen at the end of the overload test. However, as recommended, there is no basis to exclude tread damage which is permitted in the overload test. Paragraph 6.0 is revised accordingly.

One commenter suggested that paragraph 6.1.1 relating to tire test load be clarified by specifying "test surface" rather than "flywheel". However, the requirement proposed appears clear. In paragraph 6.1.2, one commenter recommended clarification with respect to inflation pressure. The commenter pointed out that rated inflation pressure applies to an unloaded tire and that the actual pressure under rated load will be higher for both the flat surface and the flywheel. Another commenter recommended that the percentage deflection at rated load should be the basis for determining the minimum loaded radius of the tire against the dynamometer. It was also recommended that the ambient temperature be identified. There is merit to the recommended clarification of paragraph 6.1.2 since the change would eliminate misinterpretation of test pressure as related to the rated inflation pressure identified under paragraph 5.3. Moreover, for the reasons previously discussed in connection with load ratings, there is reasonable basis for determining the minimum loaded radius and the identification of ambient temperatures as well as adopting the recommendation that the ambient temperature be identified by the manufacturer.

To provide a more realistic assessment of tire capability, two commenters recommended in connection with paragraph 6.1.3 that the high-speed dynamometer tests, including the overload takeoff test, be conducted on one tire test specimen. The proposed option for allowing a new tire to be tested to the overload test requirements of paragraph 6.3.3.3 was based on the need to perform destructive inspection on the original test specimen which had been subject to previous taxi and takeoff test cycles in accordance with paragraph 6.3.3.2 and 6.3.3.4. While destructive type inspection allows for a positive assessment of internal deterioration of the tire, such an inspection procedure can be performed after the tire has been subjected to all the dynamometer tests including the overload test. The use of one test specimen throughout the total test series represents a realistic condition which assures the overload capability after having been previously subjected to operational takeoff and taxi cycles. Paragraph 6.1.3 has been revised accordingly.

In paragraph 6.2.1 concerning test temperatures for low-speed tires, several commenters recommended the deletion of "... at any point on the tire ..." in the second sentence. One commenter stated that it is not necessary to determine the starting temperature at every point on the tire for the stated 90 percent of test cycles, and that the starting temperature for the remaining 10 percent of the cycles is unimportant. Two other commenters suggested that the "hottest point" be identified and used since this point controls its recycle time during the test and more nearly equates to the contained air temperature. There is merit to the suggestion that the test temperature be measured at the hottest point and the requirement has been changed accordingly. However, there is no basis for deleting the temperature requirement for 10 percent of the test cycles since the prescribed conditions provide for test uniformity with respect to an acceptable minimum starting temperature. Finally, one commenter questioned the proposed temperature and recommended that a more realistic starting temperature should be obtained from known operational data and that it should be measured on the basis of contained air at the bottom of the tire. In this connection, a need exists to base temperatures on defined operating conditions. However, precise operational information is not readily available at this time, and the temperatures prescribed are intended to set safe limits. Research and development programs are presently being undertaken to obtain useful realistic operating temperature data which can be correlated with laboratory tests.

Paragraph 6.2.2 of the standard states kinetic energy requirements. One commenter recommended that the FAA re-examine the need for retaining the deceleration (energy absorption) type dynamometer requirements, since dynamometers are presently available to test all tires to the takeoff profile specification. However, it does not appear advisable to eliminate the use of the energy absorption type dynamometer since information from manufacturers indicates that takeoff type equipment is not available for testing low-speed tires. As discussed under paragraph 6.3, the limited takeoff dynamometer facilities must be used for high-speed tire tests. Another commenter indicated that the energy conversion constant was in error and should be 0.011 as currently required. As discussed in the preamble of Notice 79–7, the proposed energy constant .011 (derived in terms of mph) was changed to .0113 to accommodate its use with an equivalent factor .015 (derived in terms of knots) established under the military tire specification MIL–T–5041G. This change will allow the testing of both civil and military tires to the same kinetic energy value. Both of the constants, .011 and .015, were derived on the basis of general assumptions relative to the absorption of kinetic energy by the brake and tire. The change to the more correct value is relatively small and will not be significant to manufacturers, particularly since tires (speed rating of 160 mph or less) may continue to be manufactured under previous approvals as discussed under § 37.167(d). Paragraph 6.2.2 is adopted as proposed.

In paragraph 6.2.4 of the standard three commenters pointed out an error which existed in the formula for computing kinetic energy absorption time. Paragraph 6.2.4 is revised to correct this error.

One commenter on paragraph 6.3 of the standard applicable to high-speed tires recommended a rewording to more accurately define the high-speed test condition and to require the airframe manufacturer to define and supply the takeoff details. The paragraph is revised to clarify and further define the high-speed test condition. However, the recommendation that the included test curves must be supplied by the airframe manufacturer is not accepted. Tire manufacturers may produce and qualify tires to any set of load-speed-time data they choose. The use of these tires is adequately regulated by the provisions of FAR Part 25, which appears to meet the commenter's concern.

For the high-speed tire test temperature requirements of paragraph 6.3.1, two commenters recommended that the specified temperature be that of the hottest point of the carcass but not less than 120°F for the taxi test and not less than 105°F (as stated in paragraph 6.2.1) for all other tests. The recommendation was based on the higher tread temperature experienced in the laboratory as compared to in-service conditions. It was pointed out that the higher recycle temperature (120°F) may result in a tire design detrimental to economic field operation with no increase in safety and that 105° is used as the starting takeoff temperature under Department of Defense Specification MIL–T–5041G. Another commenter indicated that the 120°F starting temperature may not be representative and that a time between cycles should be established relating to actual operating conditions. Two commenters recommended that the 120°F apply to the tire air or carcass temperature at the start of 90 percent of the test cycles except for the overload test which should begin at 105°F. The FAA agrees that the measurement of tire temperature should be made at the hottest point. However, the 105°F starting temperature for takeoff cycles and alternate test permits achieving a peak test temperature consistent with actual peak temperatures seen in service. Since a higher test temperature would not provide any clear benefit and could unnecessarily restrict design freedom, the 105°F starting temperature is adopted. For the remaining 10 percent of the cycles of each group, the starting temperature is specified as 80°F to provide a temperature consistent with the temperature gradiant provided in paragraph 6.2.1.

In paragraph 6.3.2 of the standard, two commenters recommended a minimum reserve factor or 5 mph margin for each speed rating. However, current service experience does not support the need for such margins and no justification was provided by the commenters. The paragraph with its included table of values is adopted as proposed.

Paragraph 6.3.3 of the TSO standard specifies dynamometer cycles. One commenter suggested that the requirement be more realistic. A further comment recommended that the number of test cycles be representative of the number of flights an average tire lasts before its first retread and that the tests include landing cycles and yaw conditions. Another commenter suggested that the requirement be clarified with respect to the number of tires tested. It was also suggested that the dynamometer cycle include side-load conditions. However, the increase in the number of cycles as originally proposed is sufficient to provide for a satisfactory assessment of the minimum performance of a tire considering both tread retention and overall carcass strength. With respect to the recommended side-load test, it is recognized that the lateral loading of tires during maneuvers such as turning does result in overload conditions which have a definite effect on tire life and performance. However, the prescribed overload tests under paragraph 6.3.3.3 and taxi tests under 6.3.3.4 provide for such conditions. Paragraph 6.3.3 is adopted as proposed.

In paragraph 6.3.3.1 covering symbol definitions, one commenter recommended that to be consistent with Figures 1 and 2, the symbol "L_2"should be redefined as the rated load. Two other commenters suggested that "L_2" be redefined as zero tire load or a load equal to 1.07 times the tire load at the maximum ramp weight. Another commenter recommended that the symbol "L_0" be defined as the tire load at the start of test cycle. To provide a correct definition of symbols appropriate to Figures 1 and 2, the symbol "L_2" is applied to a zero tire load and the symbol "L_0" is applied to the tire load at the start of the cycle but not less than the rated load. The test loads required under this paragraph will, by definition, verify the rated load and, as applicable to main wheels under § 25.733(c)(1), take into account the 1.07 factor.

In response to a comment, paragraph 6.3.3.2 is amplified to indicate specifically the proper application of Figures 1 and 2 to takeoff cycles.

For the overload takeoff cycle of paragraph 6.3.3.3, one commenter recommended that a used tire (equal to half wear) be subjected to the test. In a similar vein, another commenter indicated it was unrealistic for a new tire to be used for the test when the object of the TSO is to clear the tire design for the first tread life. The comments are valid to the extent they recommend that some form of used tire, rather than a new tire meet the test. However, it is not necessary to specify a used tire. A tire that has been subjected to previous taxi and takeoff tests represents a realistic condition for assessing overload capability. The reason for this is to assure that the tire design has an overload capacity taking into account the tire service life. One commenter pointed out that maintaining the tire rated inflation pressure is an ambiguous statement and suggested that at the completion of test and when the temperature is stabilized the tire should not lose pressure at a rate greater than 10 percent per hour. It was also suggested the paragraph include a statement that good condition of tread is not required. Two other commenters recommended that the tire should maintain its pressure integrity at the completion of test. The tire need not retain rated pressure at the end of test but should not lose more than 10 percent pressure within a 24-hour period. A 24-hour pressure retention period provides a more representative measure of acceptability. To assure the pressure integrity of the tire at the completion of test, paragraph 6.3.3.3 is revised to state that requirement.

In paragraph 6.3.3.4 relating to taxi cycles, one commenter recommended that the taxi test be followed immediately by the takeoff test to represent a more realistic operating condition. Another commenter suggested that the time between taxi cycles be established at more realistic conditions. While such "spectrum-type" taxi-takeoff tests represent one approach in assessing tire performance, there is insufficient information to indicate such tests approach realistic conditions or that they provide any improvement in ability to assess tire performance. The procedures set forth under this revised standard represent an upgrading of testing which is as stringent as can be achieved within the present state of the art. The FAA will continue to monitor developments in this field and the record of new tire performance, and may elect at some future time to further strengthen test requirements if it should be necessary to provide a higher level of performance with respect to improved tread retention and carcass strength. Paragraph 6.3.3.4 is adopted as proposed.

Under the alternate dynamometer tests proposed in paragraph 6.3.3.5, two commenters indicated that the equation in paragraph 6.3.3.5.2 represents a severe energy condition which is not supported by service experience. It was recommended that the tire be tested to the 160 mph speed but at the existing kinetic energy defined under paragraph 6.2.2. Two commenters also suggested that the paragraph be rewritten to provide that landing simulation tests be permitted only for tires with speed ratings of 160 mph or less. This need for limiting the alternate tests to 160 mph was pointed out by another commenter who indicated that some high-speed tires (for use above 160 mph) existed which had carcass failures after they were qualified to the reverse takeoff (energy absorption) type test. The commenter questioned the availability of the load-speed-time data and recommended that it be made available by the manufacturers. One commenter pointed out that the 160 mph landing speed does not account for higher speed conditions that are associated with large turbojet aircraft. Finally, other commenters objected to the proposed change in testing tires up to 160 mph indicating that it would have an adverse economic impact on them and that the high cost of installing a new dynamometer to meet the 160 mph test requirement would have a resultant inflationary cost and not yield any additional benefit to the consumer.

Paragraph 6.3.3.5 provides an alternate and equivalent test for tires in the 120–160 mph range when the load-speed-time data needed for the takeoff type test (paragraph 6.3.1) has not been established. The energy level proposed for the alternate dynamometer test may be too conservative in view of current service experience which indicates that tires tested to existing energy levels perform satisfactorily. Since most new tire designs will be supported by load-speed-time data, the alternate test will retain the existing energy levels while requiring that the tire be tested at its maximum speed rating (160 mph) to demonstrate its high speed integrity. As provided in paragraph 6.3, all tires with speeds above 160 mph will be tested on the takeoff type dynamometer equipment. It should be noted that the costs of these tests to low-speed tire manufacturers are minimal since most low-speed tires are operated below the 120 mph limit even though they are rated at 160 mph under the existing standards. Therefore, the testing requirement is unchanged from the existing standard. In this connection, the requalification of tires with a speed range of 160 mph and below will not be required under § 37.167(d). Moreover, the current definition of low-speed tire (160 mph or less) has been changed to 120 mph or less, which will benefit the low-speed tire manufacturers with limited equipment capability and help assure that tires are tested at speeds and associated energy values which are experienced in service. The requirements are restated under a new paragraph to clarify the optional application to tires with ground speeds of 160 mph or less. Paragraph 6,3.3.5 as revised is redesignated and adopted as paragraph 6.3.4.

Section 7.0 Requalification tests.

Two commenters recommended that the word "carcass" be deleted from the listing of characteristics since the carcass of the lower ply rating tire need not be identical to that of the same size tire with a higher ply rating. The recommendation is adopted. One commenter suggested that high-speed tires be exempted from the paragraph unless there is a specified percent by which the load and speed should be lower. However, the FAA is not aware of service experience to indicate that a high speed tire with a lesser ply rating should be exempted. Finally, a commenter recommended that requalification of a low-speed tire to the new standards not be required if the speed, load, and inflation pressure ratings are the same as on a tire previously approved under the existing standard. As previously discussed in connection with revised paragraph § 37.167(d), such a provision is now effective for low-speed tires previously approved.

In the proposed Figure 1, one commenter suggested simulating the combined effects of the tire rolling loads together with the rolling distance required by a rejected takeoff at that speed. The same commenter recommended that the test load curve be above the aircraft load-speed-time curve by at least 7 percent. However, as previously discussed, the combined taxi-takeoff-landing test cycle represents one approach in assessing tire performance. The test procedures are considered to be at the present state-of-the-art and will provide a higher level of performance with respect to improved tread retention and carcass strength. It should be noted that the 1.07 factor applies solely to the load rating defined and established under § 25.733, and thus the added 7 percent must be included under the test load and appropriate load-speed-time curve as requested by the commenter. Another commenter recommended that Figure 2 be renumbered to Figure 1 with title changed to "Graphic Representation of a Universal Load-Speed-Time Cycle" to show the preferred method first. In addition, the commenter stated that in Figures 1 and 2, "L_0" should be "L_2", that "RD" should apply to "T_2", and that "T_2-T_1=3 seconds." The proposed figures are revised accordingly.

Adoption of the Amendment

Accordingly Parts 25 and 37 of the Federal Aviation Regulations (14 CFR Parts 25 and 37), are amended effective December 31, 1979.

(Secs. 313(a), 601 and 603, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354(a), 1421 and 1423); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).

NOTE: The FAA has determined that this document involves a regulation which is not considered to be significant under the procedures and criteria prescribed by Executive Order 12044 and as implemented by the Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979). A copy of the final evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT".

Amendment 25-50

Airplane Cabin Ozone Contamination

Adopted: January 15, 1980 **Effective: February 20, 1980**

(Published in 45 FR 3880, January 21, 1980)

SUMMARY: This rule establishes specific airplane cabin ozone concentration standards for the issuance of type certificates for transport category airplanes. Cabin ozone standards are also adopted for the operation of large transport category airplanes by air carriers and commercial operators. The circumstances which created the need for this action were complaints of crewmembers and passengers of physical discomfort, due to ozone gas, on high-altitude flights. This action is intended to alleviate problems due to high-altitude ozone by placing limitations on acceptable levels of cabin ozone concentrations.

FOR FURTHER INFORMATION CONTACT:

Raymond E. Ramakis, Regulatory Projects Branch (AVS-24), Safety Regulations Staff, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591; telephone (202) 755-8716.

SUPPLEMENTARY INFORMATION

HISTORY

This final rule is based on Notice of Proposed Rule Making (NPRM) No. 78-15, published in the FEDERAL REGISTER on October 5, 1978 (43 FR 46034). All interested persons have been given an opportunity to participate in the making of the rule, and due consideration has been given to all matters presented. As a result of comments received and further consideration by the FAA, the following changes have been made to the rule as proposed:

1. Each ozone concentration is stated in parts per million by volume (ppmv) and expressed as a sea level equivalent, i.e., the ratio of ozone to air that would exist at 760 millimeters of mercury pressure and 25° C.
2. Under Part 121, a maximum average ozone concentration is imposed only on flight segments of more than 4 hours, instead of more than 3 hours, as proposed.
3. The time for compliance by Part 121 certificate holders has been extended from 6 months to 12 months, with provision for further extension of the compliance date if noncompliance is shown to be beyond the certificate holder's control.

DISCUSSION OF THE RULE

Background

Notice 78-15 proposed to amend Part 25 by adding cabin ozone concentration standards for the issuance of type certificates for transport category airplanes, and to amend Part 121 to adopt cabin ozone standards for the operation of large transport category aircraft by air carriers. The NPRM sets forth the extensive background supporting its issuance, including studies by the National Aeronautics and Space Administration and the Environmental Protection Agency, as well as responses to the FAA's Advance Notice of Proposed Rule Making No. 77-22 (42 FR 54427; October 6, 1977).

The proposed maximum ozone exposure levels were also supported by U.S. Department of Transportation Report No. FAA-AEQ-77-13 (ADA-046956), Ozone Concentration by Latitude, Altitude, and Month, Near 80° W, and Report No. FAA-EQ-78-03 (ADA-050988), Guidelines for Flight Planning During Periods of High Ozone Occurrence. These reports may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22151.

In addition, the FAA Civil Aeromedical Institute recently conducted research in which it studied ozone effects on 83 men and women in an altitude chamber at 6,000 feet with a relative humidity of 10-12% and a temperature of 68-74° F (20-23° C). No significant effects attributable to ozone were demonstrated for exercising subjects at an ozone concentration of 0.20 ppmv, sea level equivalent, for 4 hours. However, all exercising subjects at 0.3 ppmv, sea level equivalent, ozone showed some effects on the respiratory system. The most common symptom was coughing, and the most prominent physical effect was restriction of air flow in the bronchioles. The study demonstrated that the threshold for ozone tolerance, expressed as a sea level equivalent, lies between 0.2 and 0.3 ppmv, and that exercise may be an aggravating factor in ozone toxicity, since sedentary subjects were unaffected by an ozone concentration of 0.3 ppmv.

A number of methods to control ozone exposure have been examined, including various filtration and converter systems, disassociation of ozone by use of heat, monitoring of ozone levels with meters, the development of ozone forecasting methods, and avoidance of areas of high ozone concentration. Since each of these methods has certain beneficial aspects, and further technological developments are possible, the FAA does not favor any method over another. However, the method of compliance chosen by a certificate holder must be shown to be effective, and the FAA intends to conduct spot checks to ensure compliance with the standards adopted by these amendments.

Favorable Comments

The FAA received comments in response to Notice 78-15 from 266 individuals, airline organizations, labor organizations, research firms, manufacturers, universities, and physicians. Approximately 234 comments were received from individual flight attendants, a majority of which agreed with the one received from the Independent Union of Flight Attendants. All flight attendant comments attested to the adverse physical effects of ozone during and after flight. Shortness of breath, sore throat, bleeding nose, chest pain, fatigue, itching eyes, etc., were commonly cited physical results of ozone contamination and exposure. All flight attendants submitting comments urged that some method be found to alleviate ozone effects. Comments frequently contained information indicating the highest incidence of ozone irritation during flights for long durations at high altitudes.

Of the remaining 32 comments, 20 were in favor of the rule, 10 were opposed, and 2 provided information or made proposals that were outside the scope of the Notice.

Included among the 20 additional commenters expressing favor were professional organizations representing flight crewmembers, governmental agencies with direct knowledge of ozone contamination, manufacturers engaged in the development of filters or converters designed to control cabin ozone levels, researchers familiar with the physiological effects of various ozone exposure levels, faculty scientists of two universities, and physicians.

Ozone Concentration

Some commenters expressed confusion as to what was meant by the proposed cabin ozone concentrations. The ratios proposed were those that would be expected at the air pressure which is normally maintained in the passenger cabins of the affected aircraft (the air pressure at about 6,000 feet). However, since most ratios of this kind, including those adopted by the Occupational Safety and Health Administration (OSHA) are expressed as sea level equivalents, the ratios in this final rule have been expressed at standard sea level pressure of 760 millimeters of mercury at 25° C.

Since there is more air in a given volume at sea level, the proposed 0.3 ppmv limit converts to 0.25 as a ppmv, sea level equivalent. With this conversion, the proposed time-weighted average of 0.1 ppmv would be reduced to 0.08 ppmv, sea level equivalent. However, it was the intent of the FAA that this average be as consistent as possible with that adopted by OSHA which is an average of 0.1 ppmv on a sea level equivalent scale. Accordingly, the time-weighted average adopted by this final rule is 0.1 ppmv, sea level equivalent.

Flight Segment

Notice 78-15 proposed to impose a time-weighted average ozone concentration of 0.1 ppmv on Part 121 certificate holders for flight segments that exceed 3 hours. As explained in the Notice, only about 2 of these 3 hours of scheduled flight time would be above flight level 180. This is based on conservative times for start, taxi, takeoff, climb, descent, approach, and landing. Imposition of a time-weighted average for flights of shorter duration was considered unncessary, since these flights would have to comply with the basic 0.3 ppmv limit to be imposed on all flights, and, therefore, could not exceed the amount of ozone exposure (i.e. dose) allowed by the OSHA time-weighted average of 0.1 ppmv which is based on an 8-hour period.

Conversion of the proposed limit from 0.3 ppmv to sea level equivalent results in a new limit of 0.25 ppmv. Virtually all of the medical data reviewed by the FAA indicate that below this level short-term exposures have no significant adverse effects, while a higher limit would be expected to result in some adverse effects. In view of this conversion to 0.25 ppmv, the FAA has concluded that the rule should be based on flight segments of 4 or more hours, since operation above flight level 180 for up to 3 hours, instead of 2 hours, could still not exceed the amount of exposure (i.e. dose) allowed by OSHA. In fact, use of the proposed 3-hour flight segment in the final rule would have resulted in a stricter dose standard than that used by OHSA, as well as that adopted in new § 25.832. A stricter standard is unnecessary, since the FAA has received no complaints of ozone contamination from occupants of short-range domestic flights, and its 1978 and 1979 ozone monitoring programs have indicated only minimal ozone contamination on these flights. This revision in the final rule will avoid putting ozone reduction equipment on a large number of short-range airplanes for which no complaints have been received.

For these reasons, the minimum flight segment proposed has been extended to 4 hours. Flights scheduled for longer than this time must not exceed 0.1 ppmv average ozone concentration over the entire flight segment.

Statistical Confidence Level

Two commenters recommended that the proposed 84% confidence level required for statistics used by Part 121 certificate holders to demonstrate compliance with the ozone limits imposed by the rule be raised to 95%. However, the FAA believes that 84%, which represents one standard deviation, establishes a practical level of statistical confidence. It should be noted that the statistical confidence level only pertains to the required validity of the statistical proof of the certificate holder's ability to comply, and does not indicate a number of flights during which the ozone concentration may exceed the limit. This requirement of statistical reliability has been expressly stated in the final rule.

Ozone Sensors

The mandatory use of onboard ozone sensors was recommended by a number of commenters. However, the FAA has determined that current technology is available to effectively control cabin ozone levels without the added requirement that flight crewmembers monitor ozone levels. Manufacturers and research organization providing responses to the notice indicate that effective mechanical or electronic devices have been developed and are producing acceptable test results. The FAA knows of four manufacturers currently conducting airborne tests of control devices, and anticipates that competitive development will produce satisfactory control devices that will be proven by use of scientific test instruments. These amendments require a showing that any device proposed for use in compliance with these regulations function as intended, and the FAA will conduct spot checks to ensure their effectiveness.

Passenger Warning

Two commenters recommended that passengers be warned about the physical effects of ozone exposure. However, the FAA has determined that a warning is unnecessary, since exposure to ozone levels at or below the levels set forth in these regulations will not result in noticeable discomfort to most passengers and crewmembers. Those persons with special respiratory conditions, who may be sensitive to very low levels of ozone, can reasonably be expected to have been advised by their physicians of problems that may be encountered in high-altitude flight.

Opposing Comments

Comments objecting to the proposed rule included U.S. and foreign air carriers, airline organizations and associations, a major industrial corporation, and two physicians.

The commenters considered the proposed rule to be premature, stating that not enough information has been gathered concerning acceptable levels of ozone; that there is a lack of dependable methods to predict ozone levels on a flight-by-flight basis; that ozone attenuation factors are unknown for aircraft other than the Boeing 747; and that a compliance period of 6 months is inadequate because catalytic converter technology is not sufficiently advanced.

Ozone Research

These commenters were generally of the opinion that research on ozone exposure levels is incomplete and that control methods should not be required until physiological and technological studies in progress have been completed. However, a large number of government and industry research studies have been conducted to determine the deleterious effects of ozone exposure. All known studies have been thoroughly reviewed, and the FAA notes that with rare exception these studies are compatible with the findings of its own study conducted by the Civil Aeromedical Institute. For that reason, the FAA considers the maximum ozone exposure levels set forth in these regulations to be necessary.

FAA expects that ongoing research into the physiological effects of ozone and effective methods for its control will continue to provide a greater understanding of its effects on persons and will increasingly provide more efficient methods to eliminate excessive ozone quantities. Nevertheless, current technology is adequate to eliminate excessive levels of ozone in aircraft cabins. The FAA has determined that the available filters and catalytic converters can be installed on all affected aircraft types, and as improved filtration devices are available, they can be installed with little or no further aircraft modification.

Compliance Period

In response to recommendations that the compliance period in Part 121 be extended, that period has been changed to 12 months in the final rule. The longer period will still result in compliance prior to the 1981 ozone season, but will allow further time for compliance during the summer and fall of 1980, when the concentration of atmospheric ozone is lower.

In addition, the new Part 121 requirement allows a certificate holder to obtain an authorization to deviate from these requirements by an amendment to its operations specifications, if it shows that due to circumstances beyond its control or to unreasonable economic burden it cannot comply for a specified period of time, and submits a plan acceptable to the Administrator to effect compliance to the extent possible. A deviation will be authorized in circumstances such as equipment delivery delays or short-term use of aircraft, when the certificate holder shows that through flight planning or other means it will attempt to avoid areas of high ozone concentration.

Economic Costs

Notice 75-15 solicited comments from all interested parties on the economic effect of the proposed amendments. While the FAA did not receive detailed cost information from commenters, sufficient information does exist to estimate the possible economic cost for the aircraft operated by Part 121 certificate holders that are likely to be affected by this amendment.

The aircraft most susceptible to high concentrations of ozone are those capable of operation for extended periods in over-the-pole flights and in the higher latitudes. At present, these aircraft include the B-747, B-707, DC-8, DC-10, and L-1011 aircraft. The FAA estimates that there are approximately 780 of these aircraft now being operated by Part 121 certificate holders. About 500 of these are used in operations in the high latitudes, and may need mechanical modification to effectively control cabin ozone levels. Although no detailed cost estimates were supplied by air carriers to the FAA for modification of aircraft by type, cost information supplied by two manufacturing sources indicates that the unit price for a single catalytic converter will be between $3,500 and $7,000. The FAA estimates that installation costs for each converter will run from $1,000 to $1,350 per unit. Each aircraft involved is expected to need from two to three filters, depending on the design of the pressurization distribution system. Each converter is expected to remain in service more than 3 years.

If all 500 aircraft are modified, the range of procurement cost for initial installation of catalytic converters would be between $5.2 million and $10.5 million. Since 1 year is being allowed for compliance, it is expected that installation will occur during regular aircraft maintenance, and the total cost of installation is expected to be about $2.0 million.

Editorial Changes

Proposed § 121.578 has been adopted as § 121.220 to include it as a special airworthiness requirement under Subpart J of Part 121.

Sections 25.832(c) and 121.220(d) have been changed to clarify what must be done to show compliance with the standards imposed by those sections.

THE AMENDMENT

Accordingly, Parts 25 and 121 of the Federal Aviation Regulations (14 CFR Parts 25 and 121) are amended, effective February 20, 1980.

(Sections 313, 601, 603, and 604, Federal Aviation Act of 1958, as amended (49 U.S.C. §§ 1354, 1421, 1423, and 1424); sec. 6(c), Department of Transportation Act (49 U.S.C. § 1655(c)).)

NOTE: The FAA has determined that this document involves a proposed regulation which is significant under Executive Order 12044 as implemented by DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final regulatory evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified above under the caption "FOR FURTHER INFORMATION CONTACT:".

Amendment 25-51

Airworthiness Review Program—Amendment No. 8: Cabin Safety and Flight Attendant Amendments

Adopted: January 29, 1980 **Effective: March 6, 1980**

(Published in 45 FR 7750, February 4, 1980)

SUMMARY: The purpose of these amendments to the Federal Aviation Regulations is to update and improve the airworthiness standards applicable to cabin safety and to those affecting flight attendants. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

Everett W. Pittman, Safety Regulations Staff, (AVS-22) Federal Aviation Administration, 800 Independence Ave., S.W., Washington, D.C. 20591, telephone (202) 755-8714

SUPPLEMENTARY INFORMATION: These amendments concern cabin and flight attendant safety and are part of the Airworthiness Review Program. They are based on two Notices of Proposed Rule Making—Notice 75-10 published in the Federal Register on March 7, 1975 (40 FR 10802), and Notice 75-31 published in the Federal Register on July 11, 1975 (40 FR 29410). Because of the Federal Aviation Administration's serious concern for cabin and flight attendant safety, these proposals are being handled separately in this amendment. This action completes disposition of the proposals contained in Notice 75-10; the remainder of the proposals contained in Notice 75-31 will be treated in a subsequent rulemaking action.

The following amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR citation*
Form Number and Clarifying Revisions....	(40 FR 2576; Jan. 14, 1975).
Rotorcraft Anticollision Light Standards...	(41 FR 5290; Feb. 5, 1976).
Miscellaneous Amendments..............	(41 FR 55454; Dec. 20, 1976).
Powerplant Amendments................	(42 FR 15034; March 17, 1977).
Equipment and Systems Amendments.....	(42 FR 36960; July 18, 1977).
Flight Amendments...................	(43 FR 2302; Jan. 16, 1978).
Airframe Amendments.................	(43 FR 50578; Oct. 30, 1978).

Interested persons have been afforded the opportunity to participate in the making of these amendments and due consideration has been given to all matters presented.

BACKGROUND

In late 1978, the Administrator ordered a review of all cabin safety programs and projects within the various FAA offices. While the agency's several programs all pursued the same goal of improving safety, there was lacking a cohesiveness of effort, a central focal point. After assessing the status of these projects, the Administrator in early 1979, directed the agency to integrate all aspects of cabin safety into one program. The agency's new approach is to comprehensively deal with the problems by relating all aspects of cabin safety into a "total" cabin safety program with one program manager, the Director of Aviation Safety.

The integrated cabin safety program consists of a number of key activities which individually exist at various stages of completion. This amendment, as one element of that program, converts all but one of the proposals concerning cabin safety contained in the outstanding notices of proposed rulemaking, into final rules. The proposal concerning lower deck service compartments, § 25.819 (Proposal 8-40) has been deferred to later rulemaking action.

Other portions of the overall program, which are not dealt with in this action, concern such areas as the smoke, toxicity, and flammability characteristics of cabin interior materials and fuel explosion suppressive devices. These matters are currently the subjects of intensive research and development work which will form the basis of future regulatory standards.

The FAA's concern for improving the cabin safety environment for the traveling public, and for the flight crews and flight attendants serving that public, was underscored by the numerous comments received in response to Notices 75-10 and 75-31. While those notices contained many proposals for rule changes in other important airworthiness certification areas, the widespread concern over cabin safety has prompted the FAA to treat the subject by separate amendment at this time.

The proposals which form the basis for this amendment cover aircraft certification requirements for seats to be occupied by flight crewmembers, flight attendants, and forward observers. Relative to the seats, the proposals also speaks to seat belts and shoulder harnesses. Other items of cabin safety include stowage and service compartments, floor surfaces, and waste receptacles. In addition to the proposals related to type certification requirements, this amendment also completes action on proposals for operating rule changes that will impose some similar requirements on currently operating aircraft.

The FAA has determined that this document involves a proposed regulation which is non-significant under Executive Order 12044 as implemented by DOT Regulatory Policies and Procedures [44 FR 11034; February 26, 1979]. The regulatory evaluation prepared for the regulations is contained in the regulatory docket. A copy of the regulatory evaluation may be obtained by contacting the person identified above under the caption "FOR FURTHER INFORMATION CONTACT. . ."

DISCUSSION OF COMMENTS

The following discussion is keyed to like-numbered proposals contained in Notice 75-31. Proposals from Notice 75-10 are identified and discussed with the related Notice 75-31 proposals.

Proposals 8-36 and 2-60. In addition to the proposed revision of § 25.785 in Notice 75-31 dealing with the design and location of seats, berths, safety belts, and harnesses, a proposed Airworthiness Directive (AD), Docket No. 14912, was issued on August 7, 1975 (40 FR 34139) proposing the removal of side-facing flight attendant seats and establishing criteria for the design, location, and removal of other flight attendant seats.

Both Notice 75-31 and the proposed AD contained similar proposals for flight attendant seats, and comments were received on both proposals. An AD was subsequently issued on February 23, 1976 (41 FR 8766) to require the removal of each side-facing flight attendant seat. The AD did not require corrective action on the other items contained in the proposed AD, since it was intended that the design or removal of other flight attendant seats would be considered in connection with final rulemaking action under Proposals 8-36 and 8-117 in Notice 75-31. Comments received on the proposed AD have been considered under related proposals in Notice 75-31. The energy absorbing rest requirement of proposed § 25.785(h)(2)(i) is intended to answer numerous comments received in the AD docket relating to allegedly hazardous characteristics of certain galley mounted flight attendant jumpseats now used in air carrier service. Since § 25.785(h)(2)(i) is specifically made applicable to air carrier operations in proposed § 121.311(f), present flight attendant jumpseats not designed to provide necessary arm, shoulder, head and spine support will be prohibited from use during air carrier operations upon the effective date of this amendment.

A commenter suggested that proposed § 25.785(g) only apply to required flight crew station seats and not to other flight deck seats such as rest seats or observer seats. The FAA does not agree. Nonrequired flight station personnel occupy seats that are very close to those of required personnel and, if these nonrequired flight station personnel are not properly restrained, their unrestrained movements during an emergency situation could interfere with operations by the flight crew. Therefore, the requirement of proposed § 25.785(g) is applicable to all seats on the flight deck.

Several commenters questioned whether the words "means to secure" in proposed §§ 25.785(g) and (h) were intended to require a specific device or whether an operational procedure could be used that would require that the seat belt and shoulder harness be secured when not in use. Another commenter questioned whether the fastening of the harness around the seat when not occupied would meet the intent of the rule. The intent of the proposal for §§ 25.785(g) and (h) is to provide a means or procedure for ensuring that the restraint system, when not in use, will not interfere with normal operation of the airplane or interfere with rapid egress of personnel in an emergency situation. The fastening of the restraint system around the seat would be acceptable if it meets this intent. The work "combined" which appears between the words "be" and "means" in the second sentence of proposed § 25.785(g) has been deleted as redundant. Several commenters questioned whether the term "when not in use" in proposed §§ 25.785(g) and (h) related to not in use on a particular flight or not in use due to the seat having been momentarily vacated. However, the wording makes clear that the rule would apply in both instances.

Numerous comments were received on proposed § 25.785(h) to require that flight attendant seats be located near approved floor level exits and be equipped with a combined seat belt and shoulder harness.

Several commenters suggested that applicability of the proposed paragraph be restricted to seats provided for those attendants required by the operating rules, since excess flight attendants usually occupy passenger seats and the redesign of passenger seats to accept approved shoulder harnesses would be prohibitive in cost. The FAA maintains that all flight attendants required by § 121.391 should have seats that meet the requirements of § 25.785(h). The phrase "required by § 121.391" has been deleted from § 121.311(f) and a new § 121.311(f)(3) has been added to clarify that the requirements of § 25.785(h) are not applicable to passenger seats occupied by flight attendants not required by § 121.391.

Two commenters suggested that shoulder harnesses not be required on rearward facing flight attendant seats, stating that a seat belt alone would offer secure and safe restraint. The FAA does not agree. Lateral restraint is required for rearward facing as well as for forward facing seats. A shoulder harness provides the degree of lateral restraint necessary to warrant its use at all flight attendant seats.

A commenter questioned whether mirrors could be used to meet the intent of the proposed § 25.785(h)(1), which would require that flight attendant seats be located to provide a view of the cabin area. The intent of the proposal is to require a direct view, and mirrors or other such devices are not considered acceptable because of their limitations. The proposed § 25.785(h)(1) is therefore revised to specify "direct view" and to make nonsubstantive editorial changes.

Two commenters stated that where galley doors are used as emergency exits, the placement of the attendant seats near the floor level exit, as required in proposed § 25.785(h), could preclude compliance with the requirement of proposed § 25.785(h)(1) that the flight attendants be provided a direct view of the cabin area. To cover this situation, a commenter suggested that the § 25.785(h)(1) requirement be conditioned to apply insofar as practicable and without compromising the proximity to required floor level exits. The FAA agrees that the requirement for location of the flight attendant seats near the floor level exits in this case is more important than the requirement that the flight attendant have a direct view of the cabin. Accordingly, the proposal is revised in the manner suggested.

Another commenter stated that access to the communication system when seated is not necessary for all flight attendants, and in particular those in excess of the number required by the operating rules. After further review, the FAA has concluded that the wording of proposed § 25.785(h)(1) referring to access to the communications system when seated may be ambiguous and cause misunderstandings when compared to the newly adopted provisions of §§ 25.1411(a)(2) and 121.319 of this Chapter (Amendment 7; 43 F.R. 50578). Newly adopted § 25.1411(a)(2) describes the requirements for the public address system microphone, whereas the § 121.319 requirement for a crewmember interphone system is also regarded as a communication system. However, there is no mention in Part 25 of the crewmember interphone described in § 121.319. To make the changes necessary to resolve this ambiguity would be beyond the scope of this proposal. Accordingly, the FAA has deleted the last portion of proposed § 25.785(h)(1) referring to access to the communications system when seated. The FAA will propose future rulemaking action to incorporate provisions in §§ 25.785(h)(2)(i) and (h)(2)(ii).

Four commenters objected to proposed §§ 25.785(h)(2)(i) and (h)(2)(ii) to require energy-absorbing rests on only rearward facing seats and suggested that forward facing seats also be required to have such rests. The FAA agrees, and the proposed § 25.785(h)(2) has been revised accordingly. A commenter suggested that the proposed § 25.785(h)(2) is redundant, since current § 25.785(c) already requires a seat with energy absorbing rests. The FAA does not agree. The § 25.785(c) requirement does not specify the energy absorbing rest that would be required by § 25.785(h)(2) for rearward and forward facing flight attendant seats.

Two commenters suggested deletion of the word "arms" if the intent is to require arm rests or side panels, for these would preclude the use of the fold-up seats needed to provide the necessary clearance and access to aisles and exits. The proposed rule is not intended to eliminate the use of fold-up seats. The intended arm support could be provided by a sufficiently large seat back, and this would not preclude the use of fold-up designs. Another commenter suggested that clarification of the work "energy absorbing rest" is necessary and suggested that the term "padding" was less confusing. The FAA believes that the term "energy absorbing rest" as currently employed in present § 25.785(c) is sufficiently clear and unambiguous. Moreover, introducing new terminology at this time would only lead to confusion.

Several comments were received on proposal § 25.785(h)(3), which would require that flight attendant seats be positioned to prevent interference with the use of passageways and exits. The commenters questioned whether the requirement would apply to unoccupied flight attendant seats. The FAA agrees that the proposed requirement should be clarified and it has been revised to indicate that the requirement applies to flight attendant seats when not in use. Revised § 25.785(h)(3) has been redesignated and adopted as § 25.785(h)(2)(ii).

A commenter suggested the addition of a new § 25.785(h)(4) to state requirements for the design and location of supplemental oxygen equipment for use by the flight attendants. Since standards for the location of such equipment are presently under consideration in the Operations Review, that suggestion will be treated as a part of the Operations Review rulemaking.

A commenter suggested deletion of the words "during any operation" from the proposed § 25.785(j), which would require that each seat be located to minimize the probability of its occupant suffering injury by being struck by dislodged items. The commenter stated that the phrase was meaningless, unnecessary, and would be a source of never-ending controversy as to its intent. The FAA agrees, and proposed § 25.785(j) has been revised accordingly.

Several commenters questioned whether the proposed § 25.785(j) was intended to pertain to all passenger and flight attendant seats or merely to flight attendant seats. A commenter suggested that injury from dislodged contents of galleys or storage compartments is common to all seats in the cabin and that the flight attendant seats should not be singled out for action. Consistent with the wording of the previously issued AD dealing with flight attendant seats, the intent of proposed § 25.785(j) in Notice 75-31 was directed to flight attendant seats. Although all occupants of an airplane should be protected from injury from dislodged items, the FAA does not agree that all occupants are vulnerable to flying debris by reason of seat location. The flight attendant seats, being adjacent to exits, are frequently in aisles, passageways, or near galleys, and are therefore more vulnerable to being struck by objects dislodged from closets, galleys, supply racks, or shelves. Service experience shows that flight attendants are struck more often than other cabin occupants and proposed § 25.785(j) is revised to clarify its applicabililty to flight attendant seats.

Another commenter suggested that a strict interpretation of proposed § 25.785(j) would result in an incompatibility with the requirements that cabin attendant seats be near or adjacent to approved floor level exits, especially when such exits are galley service doors. The commenter suggested inclusion of the phrase "insofar as is practicable and without compromising the proximity to approved floor level exits. . . ." The FAA does not agree. The requirement that flight attendant seats be located near approved floor level exits should not be compromised nor should locating such seats near galleys compromise the safety of the seated flight attendant. In this connection, proper galley design and seat location can greatly minimize the probability of the flight attendant being injured by dislodged items.

Finally, one commenter suggested a revision to § 25.785(j), by listing specific items to be considered in minimizing the likelihood of occupants being injured by dislodged items. The same commenter proposed that the description of likelihood of injury be changed from a "probability" to a "possibility". The FAA does not agree. Proposed § 25.785(j) would require that flight attendant seats be located to minimize the "probability" of occupant injury from dislodged items. Substantial design difficulties would be encountered in locating flight attendant seats to minimize harm from any possibility during flight operations. The commenter's proposal would create the unwarranted implication that seat locations be subject to statistical analysis. Nor is the necessary to enumerate all items capable of being dislodged, as the proposed wording would require that all items normally found in galleys, storage compartments, and serving carts must be considered. The same commenter's further suggestion for specifying means for securing all stowage compartments and related loose items is unnecessary since such structural considerations are adequately covered in the wording of § 25.785(j).

Disposition of Proposal 2-60 to amend § 25.785 (Notice 75-10) was deferred at the time of issuing the amendment published at 41 FR 55454 so that it could be considered in connection with Proposal 8-36. No unfavorable comments were received on Proposal 2-60. However, in view of the changes being made to § 25.785 under Proposal 8-36 of Notice 75-31, the changes proposed in 2-60 of Notice 75-10, with the exception of the word changes in paragraph (i) and the addition of a new paragraph (h), are unnecessary and are withdrawn. Proposed paragraph (h) concerning the forward observers' seat is adopted and redesignated as § 25.785(k).

Proposal 8-37. Two commenters objected to the wording "extremely improbable" in the proposed revision to § 25.787(b). One commenter stated that this wording implies a requirement for a reliability analysis, which the commenter indicated was unwarranted. The FAA concurs, and the requirement that an unwanted opening be extremely improbable is withdrawn.

Two commenters suggested that the intent of proposed § 25.787(b) is adequately covered in present § 25.789. However, the intent of the proposed section is to prevent inadvertent opening of the latched doors of stowage compartments by specifically requiring that service wear and deterioration be considered in the design. The § 25.787(b) requirement is therefore different than the § 25.789 requirement which is directed to retention of items of mass subjected to maximum load factors.

After consideration of the comments received and after further review, the FAA has determined that a clarification of the proposal is needed to indicate that the proposal applies only to stowage compartments in passenger and crew cabins. The proposal is revised accordingly.

Proposal 8-39. A commenter objected to the proposal for a new § 25.793 to require slip resistant properties on floor surfaces of all areas likely to become wet, stating that there appears to be no such hazard in general aviation airplanes. The FAA does not agree. Airplanes type certificated under Part 25 may be operated both as air carrier and general aviation type airplanes. Any transport category aircraft may be susceptible to this problem regardless of its type of operation.

A second commenter suggested that the wording of the proposal be revised to require consideration only of those areas "likely to become wet in service." The FAA agrees and the proposal is revised accordingly.

Several commenters questioned the term "slip resistant" as used in the proposal. A commenter stated that a definition of the term should be adopted. The FAA maintains that the term "slip resistant" is generally understood, and that no useful purpose would be served by providing a rigorous definition which might unduly restrict design choice.

Proposals 8-42, 2-18, 2-65, 2-114 and 2-160. Proposal 2-65 to revise § 25.853(c) is similar to Proposals 2-18, 2-114 and 2-160 to revise §§ 23.853(c), 27.853(c), and 29.853(c), respectively. Each of these proposals was set forth in Airworthiness Review Notice No. 2 (Notice 75-10) and their disposition was deferred for consideration with Proposal 8-42 (see Amendment No. 3 (41 FR 55454)). All comments on Proposals 2-18, 2-65, 2-114, and 2-160 are discussed herein.

Commenters pointed out that proposed § 25.853(c) contained "No Smoking" sign provisions which were already set forth in current § 25.791, and suggested that one or the other be revised to avoid confusion. The FAA agrees and § 25.853(c) has been revised to refer to § 25.791 for the requirements for signs that notify passengers when smoking is prohibited. Because of this revision to Proposal 8-42, § 25.853(c) is not identical to §§ 23.853(c), 27.853(c), and 29.853(c); however, substantively identical language exists in § 25.971, referenced in the revised § 25.853(c). If § 25.853(c) were to be identical to §§ 23.853(c), 27.853(c), and 29.853(c), corresponding changes to § 25.971 and § 121.317(a) would be necessary. Such changes would unnecessarily complicate this amendment and would provide no meaningful advantage.

A commenter objected to proposed § 27.853(c)(2) on the grounds that "No Smoking" signs are not justifiable for normal category rotorcraft, which are limited to 6,000 pounds gross weight. It was contended that the passenger capacity of such rotorcraft is relatively small and that even when the crew and passenger compartments are separated, a simple "No Smoking" placard, or oral instructions from the crew, or both, would accomplish the intent of the proposal. With regard to a "No Smoking" placard, the FAA agrees that such a placard would be sufficient if smoking is to be prohibited. However, the FAA believes that when the crew compartment is separated from the passenger compartment, oral communication from crew to passenger may not be possible.

A commenter suggested that the distinction between the term "when illuminated" in proposed § 27.853(c)(2)(i), and the term "when illuminated internally" in proposed § 27.853(c)(2)(ii), should be made more clear. The FAA's intent was to require the lights to be so constructed that the crew can turn them on and off, consistent with similar requirements in current §§ 25.791, 121.317 and 127.115. Accordingly, the term "when illuminated internally" is deleted from §§ 23.853(c)(2)(ii), 27.853(c)(2)(ii) and 29.853(c)(2)(ii).

Several commenters objected to the requirement in proposed § 25.853(d) (Proposal 8-42) that towel, paper, and waste receptacles be fireproof, contending that—(1) Experience and tests have demonstrated that proper design using fire resistant materials provides entirely adequate fire containment; (2) the other requirements in proposed § 25.853(d) ensure fire containment in fire resistant receptacles; and (3) use of fireproof rather than fire resistant materials would result in a considerable weight penalty, particularly on large airplanes. In light of these comments, and after further consideration, the FAA concludes that fire resistant materials would be adequate for these receptacles. Proposed § 25.853(d) is revised accordingly.

Two commenters pointed out that proposed § 25.853(d) could be construed as applying to towel and paper dispensing equipment. The FAA's intent was to cover only those receptacles that are used for the *disposal* of towels, paper, and waste since these are receptacles in which fires have occurred in service. To make this clear, § 25.853(d) is revised by inserting the word "disposal" before the work "receptacle."

A commenter objected to the term "extremely improbable" in proposed § 25.853(d) because it implies a type of reliability analysis which the commenter claimed would not be appropriate to the requirements specified. Another commenter objected to the same term on the ground that it would be impossible to demonstrate. The FAA agrees that "extremely improbable" is not appropriate and the second sentence of § 25.853(d) is revised to read ". . . under all probable conditions of wear, misalignment, and ventilation expected in service. . . ." The word "effects" is deleted as redundant.

One commenter stated that proposed § 25.853(d) would require that the receptacle have a lid and that this may not be practical when a chute leads from a spring-loaded door in the sink counter top into a container below. The FAA believes that a practical design complying with the proposal can be achieved by considering the combination of spring-loaded door, chute, and container as constituting the receptacle.

Two commenters objected to proposed § 25.853(e), stating that it was more restrictive than Airworthiness Directive (AD) 74-08-09, which deals with similar safety issues. In particular, the commenters stated that the AD allowed the use of— (1) "No Smoking" signs as an alternative to "No Smoking in Lavatory" signs; (2) signs "of sufficient size and contrast" as opposed to the proposed "red letters at least one inch high on a white background of at least two inches high"; (3) one ashtray to serve more than one lavatory door if the ashtray could be seen readily from the cabin side of each lavatory served. Concerning the first and third points, the FAA finds, after further consideration, that the less restrictive language in the AD would provide an adequate level of safety. Concerning the second point, the FAA believes it is necessary to require minimum standards for the size and contrast of the placards specified in proposed § 25.853(e). However, after further consideration, the FAA has concluded that these placards would be sufficiently conspicuous if the red letters and white background were one-half inch high and one inch high respectively. Section 25.853(e) is revised accordingly.

A commenter suggested that proposed § 25.853(e) be revised to allow the use of symbols to indicate "No Smoking in Lavatory" instead of letters. The FAA maintains that for lavatory placards, letters rather than symbols must be used to minimize the probability that the placard message would not be understood by the lavatory occupant. In contrast to the situation in the general cabin area, there would not be a person nearby who could explain the symbol if its meaning were not grasped. However, symbols may be included on the placard with the letters to further describe the no smoking condition.

A commenter who supported proposed §§ 25.853(d) and (e) suggested that additional regulations should be developed to provide an active means of fire detection and extinguishing in compartments such as lavatories; however, the commenter did not make any specific recommendations.

Proposal 8-52. No unfavorable comments were received on the proposal to amend § 25.1413(c). Accordingly, the proposal is adopted without substantive change.

Proposal 8-116. Several commenters agreed in principle with the proposed § 91.200 to add a requirement that transport category aircraft be equipped with shoulder harnesses meeting the requirements of § 25.785 at each crewmember seat and flight attendant seat. Two of these commenters disagreed with the proposed one year compliance time, stating that two or three years was a more appropriate compliance time. The FAA finds that the one year proposed is a realistic time for accomplishing these tasks. However, the FAA recognizes that conditions beyond the control of an operator can occur to delay compliance with the rule. This could be the case even though a good faith effort was made by an operator to comply. Because of this, the proposal has been revised to provide, under appropriate circumstances, for a limited extension of the compliance date in accordance with a schedule acceptable to the FAA. Before granting any extension, the FAA will scrutinize each operator's request to determine if the operator made the showing required by § 91.200(b). In addition to demonstrating that circumstances beyond its control make timely compliance impossible, the operator must submit a schedule showing that compliance will be achieved at the earliest practicable date. Any extension granted will be based upon the FAA's judgment as to the earliest date on which compliance is possible.

A commenter stated that some airplanes do not have adequate structure available at some flight attendant and jump seat locations to install a supported shoulder harness, particularly at those seats which are side facing. However, side-facing seats are no longer an issue since Airworthiness Directive 76-05-02 (Docket No. 14912, Amendment No. 39-2534) requires the removal of side-facing flight attendant seats from all transport category airplanes.

A commenter suggested that the proposal be revised to require compliance only when flight attendants are being carried, rather than at all times a flight attendant seat is installed. The commenter pointed out that some airplanes operate under Part 91 when conducting ferry or training flights. The FAA does not agree, since Proposal 8-117 would require that shoulder harnesses be installed for operations conducted under Part 121 and they would therefore already be in the airplane for the operation described by the commenter.

Several commenters on Proposal 8-117 pointed out that certain existing shoulder harness installations at pilot-in-command, second-in-command, and flight engineer stations are designed to less than the present 9_g forward load factor requirement of § 25.785, and that to require a redesign to 9_g would be impractical and prohibitive in cost. Other commenters noted that many flight attendant seats already have FAA-approved shoulder harnesses but not all are "combinded safety belts and shoulder harness unit(s) with a single point release." The commenters stated that these installations have proved satisfactory in service and, since the operators voluntarily installed such FAA-approved shoulder harnesses, it would be unfair to now penalize them by requiring a retrofit restraint system with a single point release. The FAA finds that the comments submitted on Proposal 8-117 are equally appropriate for Proposal 8-116 and agrees with the commenters' recommendations. Proposed § 91.200 has been appropriately revised to allow the use of previously installed restraint systems at crewmember stations, provided the crewmember can perform assigned duties with the restraint system fastened, and it allows for existing restraint systems which were designed to the inertial load factors established under the certification basis of the airplane.

See proposals 8-117 and 8-36 for related discussions.

Proposal 8-117. As in Proposal 8-116, several commenters objected to the proposed changes to § 121.311 which would require shoulder harnesses at each flight deck station. Several commenters also pointed out that shoulder harness installations now exist on airplanes which are designed to less than the present 9_g requirements of § 25.785. Other commenters noted that many flight attendant seats already have FAA-approved shoulder harnesses but not all possess a single point release. For a discussion of all of these comments see Proposal 8-116. Qualifying statements have been added to the proposal to revise §§ 121.311(e) and (f). These changes are substantively identical to those added to § 91.200(a) and discussed in Proposal 8-116.

A commenter objected to the requirement in proposed § 121.311(f) that would require all flight attendant seats to meet the requirements of § 25.785 of this chapter. The commenter stated that some passenger seats are being used for required flight attendants due to their proximity to floor level exits. The FAA maintains that all flight attendants required by § 121.391 should have seats that meet the requirements of § 25.785. The phrase "required by § 121.391" has been deleted from § 121.311(f) and a new § 121.311(f)(3) has been added to clarify that the requirements of § 25.785(h) are not applicable to passenger seats occupied by flight attendants not required by § 121.391.

A commenter pointed out that there was no time period for effecting compliance and suggested at least two years be allowed for retrofit of these restraint systems. In order to provide some time for compliance, proposed § 121.311(f) is revised substantively identical to revised § 91.200(b) (see Proposal 8-116).

Several commenters pointed out that the compliance time proposed for §§ 121.311(e)(2), (f), (g), and (h) does not permit adequate time for design, fabrication, and retrofit. The FAA is satisfied that the time proposed is a realistic period for accomplishing these tasks. However, the FAA recognizes that conditions beyond the control of a certificate holder can occur to delay compliance with the rule. This could be the case even though a good faith effort was made by a certificate holder to comply. Because of this, proposed §§ 121.311(e)(2), (f) and (h) have been revised to provide, under appropriate circumstances, for a limited extension of the compliance date in accordance with a schedule acceptable to the FAA. Section 121.311(j) describes the prerequisites for any operator to obtain an extension of the compliance dates established by the amendment. To be eligible for an extension, each operator must demonstrate that it is unable to comply due to circumstances beyond its control. In addition, the operator must submit a schedule showing that compliance will be achieved at the earliest practicable date. Any extension granted under this provision will be based upon the FAA's judgment as to the earliest date on which compliance is possible.

A commenter pointed out that proposed § 121.311(h) requires that each occupant of a seat equipped with a shoulder harness have the restraint system secured about him/her during takeoff and landing but does not require the occupant to be able to perform assigned duties with the shoulder harness fastened. Since the obvious intent of proposed § 121.311(h) was to require that the occupant of the seat be able to perform assigned duties with the shoulder harness attached, proposed § 121.311(h) is revised accordingly.

No unfavorable comments were received on the proposal to amend § 121.311(i) and the proposal is adopted without substantive change.

Proposal 8-118. The FAA withdrew the proposed new § 121.312(b) in a Notice published in the Federal Register on August 24, 1978 (43 FR 37703).

A commenter pointed out that airplanes in service have already been required to comply with the essential substance of proposed new § 121.312(c) by means of Airworthiness Directive 74-08-09, which applies to all transport category airplanes, and recommended that this proposal be deleted. The FAA agrees. Airworthiness Directive 74-08-09 applies to airplanes operated under Parts 91, 121, and 135 of the Federal Aviation Regulations, and the proposed new § 121.312(c) is redundant with respect to airplanes operated under Part 121. The proposed new § 121.312(c) is therefore withdrawn.

Proposal 8-119. No unfavorable comments were received on the proposal to delete § 121.321. Accordingly, the proposal is adopted without substantive change. For related discussion see Proposal 8-117.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 23, 25, 27, 29, 91, and 121 of the Federal Aviation Regulations are amended effective March 6, 1980.

(Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, and 1424); and Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE: The FAA has determined that this document involves a proposed regulation which is non-significant under Executive Order 12044 as implemented by DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the regulatory evaluation prepared for the regulations is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified above under the caption "FOR FURTHER INFORMATION CONTACT . . ."

Amendment 25-52

Technical Standard Order (TSO) Revision Program

Adopted: June 2, 1980 **Effective: September 9, 1980**

(Published in 45 FR 38342, June 9, 1980)

SUMMARY: The purpose of these amendments is to adopt a new public procedure to expedite the issuance of standards, known as Technical Standard Orders (TSO), for specified materials, parts, processes, and appliances used on civil aircraft. In accordance with Executive Order 12044, Improving Government Regulations, the new procedure will expedite TSO issuance and amendment, and will result in the substantial reduction of existing regulatory material. Consistent with the President's goal of reforming the regulatory process to eliminate unnecessary requirements, these amendments will enable the FAA to issue and amend TSO's in a timely manner. In addition, it is part of the FAA's continuing effort to simplify the Federal Aviation Regulations. The expeditious issuance of new TSO's and amendment of existing TSO's (presently published as Subpart B of Part 37) are necessary to stay current with the continuing growth and technological advances in aeronautics.

FOR FURTHER INFORMATION CONTACT:

Mr. Eli S. Newberger, Regulatory Projects Branch, AVS-24
Safety Regulations Staff
Associate Administrator for Aviation Standards
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591; Telephone (202) 755-8716.

SUPPLEMENTARY INFORMATION:

BACKGROUND

Whenever a material, part, process, or appliance is to be used on an aircraft, it must be approved under the Federal Aviation Regulations (FAR) before it can be utilized. The approval can be obtained in one of the following ways: (1) under a Parts Manufacturer Approval issued under 14 CFR 21.303; (2) in conjunction with type certification procedures for a product, including approvals granted by a supplemental type certificate; (3) under a Technical Standard Order authorization or approval issued under 14 CFR Part 37; or (4) in any other manner approved by the Administrator.

One of the several methods of obtaining approval is by designing and testing the article (material, part, process, or appliance) in accordance with a TSO which contains minimum performance and quality control standards for specified articles. The standards for each TSO are those the Administrator finds necessary to ensure that the article concerned will operate satisfactorily. Since compliance with a TSO is only one method of obtaining an approval, the standards contained in the TSO are not mandatory but are only an optional way of obtaining approval for a particular article. For example, an applicant can obtain approval to deviate from a particular TSO if it shows that the design features provide an equivalent level of safety.

A TSO is not a standard of general or particular applicability designed to implement or prescribe law or policy. It does not fall within the definition of "rule" contained in the Administrative Procedure Act (5 U.S.C. 551). There is no requirement that a TSO be published as a notice of proposed rule making in the *Federal Register*.

Future TSO's will, through incorporation by reference, make maximum practical use of "voluntary standards" as defined by the Office of Management and Budget (OMB) Circular A-119, "Federal Participation in the Development and Use of Voluntary Standards," issued January 17, 1980 (45 FR 4326). By definition of OMB Circular A-119, "voluntary standards" are established generally by the private sector "voluntary standards bodies" and are available for use by any person or organization, private or government. The term includes what are commonly referred to as "industry standards" as well as "consensus standards" but does not include professional standards of personal conduct, private standards of individual firms, or standards mandated by law. "Voluntary standards bodies" are nongovernmental bodies which are broad based, multimember, domestic, and multinational organizations including, for example, nonprofit organizations, industry associations, and professional technical societies which develop, establish, or coordinate voluntary standards.

The FAA has determined, for the reasons stated in Notice 79-15, published in the *Federal Register* on October 1, 1979 (44 FR 56370), that, in the interest of safety, it is appropriate to adopt new public procedures to facilitate the issuance of TSO's for specified articles used on civil aircraft. The safety aspect of this rule making is particularly important. The fact that TSO's have been part of the complex regulatory structure of the FAA has caused a substantial lag time between regulations and state of the technology. This procedural change should advance by months and even years the implementation of technological improvements in the U.S. aviation system.

Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented. Significant comments received in response to Notice 79-15 are discussed below. A number of substantive, editorial, and clarifying changes have been made to the proposed rules based on relevant comments and on further review within the FAA. Except for minor editorial and clarifying changes and the changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notice 79-15.

These amendments are consistent with the agency's responsibility to review the continuing need for regulations and the need to eliminate unnecessary regulations. By eliminating TSO's from the regulations, previously published as Subpart B of 14 CFR Part 37, and making them available through the multiple procedures described below, the FAA has improved the availability of the TSO's and made it easier for the public to locate the most up-to-date standard. In addition, by removing TSO's from the agency's regulatory process, the time available for other matters within the regulatory system will be increased. This will enable the agency to respond in a more timely manner to other issues submitted by the public. This improvement of the regulatory process, to be more responsive to the public, is consistent with Executive Order 12044, issued by President Carter on March 23, 1978.

DISCUSSION OF COMMENTS

Twenty-two individual sets of public comments were submitted in response to Notice 79-15. Several of the commenters were associations that presented the views of manufacturers, operators, and pilots. While the great majority of the commenters were in general agreement with the objective of the proposal, a number of them suggested changes, requested clarification or guidance, and offered specific criticisms. Other commenters proposed changes that are beyond the scope of this rule making.

DISCUSSION OF COMMENTS TO THE NEW PUBLIC PROCEDURE

In general, the commenters concerned themselves with the following questions: How would TSO authorizations be obtained? Would foreign countries accept them? How would a request for approval to deviate from any performance standard be handled? How would an interested party request a revision to a TSO? How would a current TSO be affected when a revision to the TSO is made? How would the public comment on a draft TSO? How would the FAA revise the sections of the Federal Aviation Regulations which reference a TSO by TSO number? One commenter expressed concern that adopting the proposal would abolish existing TSO's.

Based on comments received, the FAA has determined that the proposed new public procedure may not have been fully understood as it was explained in Notice 79-15. The purpose of the new public procedure is to expedite the issuance of TSO's for specified articles used on civil aircraft by deleting unnecessary rulemaking steps and by deleting unnecessary material from the regulations. This effort is consistent with Executive Order 12044. There is no change in the requirements for the issuance of TSO authorizations which are relocated from Subpart A of Part 37 to new Subpart O of Part 21. There is no change in the procedure to issue TSO authorizations, to process requests for approval to deviate from any performance standard, or to request a revision to a TSO. Existing holders of TSO authorizations will continue to retain their current status when new or amended TSO's are issued, unless otherwise specified in the TSO. Manufacturers may request approval to deviate from any TSO using the same procedures as before, now described in new § 21.609.

The new public procedure does not affect the right of the public to comment on a proposed TSO. The public will continue to be invited to participate in the development of documents prepared and issued by industry organizations which the FAA will use by reference in a TSO. The FAA will use the rulemaking process to revise the sections of the Federal Aviation Regulations which reference a TSO by TSO number when there is a need to change the referenced TSO number. The FAA will make available to any interested person an index of each current TSO and each TSO the FAA anticipates will be issued within the succeeding 12 months. The FAA will also invite comments from interested persons on each proposed TSO using a notice in the *Federal Register*.

PUBLIC PROCEDURE

The following is the public procedure, in detail, the FAA will use to develop and issue final TSO's for specified articles used on civil aircraft:

- The FAA will continue to develop draft TSO's and will continue to use, by reference in the TSO, documents prepared and issued by organizations such as the Radio Technical Commission for Aeronautics (RTCA) and the Society of Automotive Engineers (SAE). Notices of RTCA meetings and invitations will continue to be published in the *Federal Register*. This will allow public participation at the early stages of document development.
- Any interested person may request the Administrator to revise or issue a new TSO by submitting a description of the revision sought or a description of the new article for which a TSO is requested.
- The FAA will use several methods to ensure that the public is afforded early opportunities to take part in the TSO decisionmaking process. A draft TSO will be circulated for public comment through the use of mailing lists. Any individual or organization can request to be placed on the TSO mailing list. All those on the list will receive drafts of each TSO. In addition, Advisory Circular 20-110, Index of Aviation Technical Standard Orders, will list those TSO's the FAA anticipates will be issued within the succeeding 12 months. Advisory Circular 20-110 will also list each current TSO and provide information on how to obtain copies of those desired. Finally, the FAA will publish periodically a notice in the *Federal Register* of each proposed TSO and provide notice of how to obtain a copy.
- Any individual or organization wishing to obtain copies of Advisory Circular 20-110, specific draft TSO's, or all such TSO's proposed by the FAA may be placed on a mailing list by submitting a request addressed to the Federal Aviation Administration, Office of Airworthiness, Aircraft Engineering Division, Systems Branch (AWS-130), 800 Independence Avenue, S.W., Washington, D.C. 20591, or by telephoning (202) 426-8395. Interested persons will receive copies of the Advisory Circular and copies of those draft TSO's requested. Any person wishing to submit comments on a proposed TSO will be given 90 days from its issuance date to submit comments.
- All comments received on or before the closing date for comments will be considered by the Administrator before issuing a final TSO.
- All comments submitted will be available, both before and after the closing date for comments, for examination by interested persons in Room 335, FAA Headquarters Building (FOB-10A), 800 Independence Avenue, S.W., Washington, D.C. 20591, between 8:30 a.m. and 5:00 p.m.
- Copies of the final TSO will be mailed to all persons on the mailing list. As in the past, documents prepared and issued by an organization that are incorporated by reference in the TSO will continue to be available to any interested person only from that organization. Final TSO's will not be published in the *Federal Register*.

- Copies of all draft and final TSO's will also be available at FAA Headquarters in the Office if Airworthiness, Aircraft Engineering Division, Systems Branch (AWS-130), and at all regional Flight Standards Engineering and Manufacturing offices.

In summary, the new procedure has numerous opportunities for the public to participate in the development of each TSO. These are: (1) participation in the development of documents prepared and issued by industry organizations, which the FAA may use by reference in a TSO; (2) mailing lists to circulate a draft TSO to the public for comment; (3) an advisory circular to list for the public each TSO the FAA anticipates will be issued within the succeeding 12 months; (4) notice in the *Federal Register* announcing the availability of each draft TSO and invitation for comment; and (5) at least 90 days to submit comments.

DISCUSSION OF GENERAL COMMENTS

One commenter recommended tightening the TSO requirements, citing three airplane incidents (the loss of a piece of tail, the loss of a wing flap, and the failure of a rear bulkhead). This amendment does not address the requirements of any individual TSO. Furthermore, TSO authorizations are not issued for the airframe parts that the commenter cited. FAA approval for these airframe parts is accomplished under the type design approval for the specific airplane.

One commenter cited TSO references in §§ 91.24(a), 91.52, and 121.360 and questioned if the FAA plans to revise these sections to delete the referenced TSO. The FAA is not revising the referenced TSO in these sections. Since Part 37 is being revoked by this amendment, references to TSO's using sections of Part 37 (§ 37.XXX) are revised to reference each TSO by the TSO number.

One commenter stated that there may be problems relating to the enforcement of the provisions of Advisory Circular 20-110 under proposed §§ 21.603(a), 21.607(a), 21.609, and 21.611. It is unclear to what this commenter is referring since the advisory circular merely lists each current TSO and each TSO the FAA anticipates will be issued within the succeeding 12 months.

DISCUSSION OF COMMENTS TO § 11.49(b)

Present § 11.49(b)(2) delegates authority to the Director, Flight Standards Service, to issue, amend, and repeal TSO's under Part 37. The notice proposed deletion of this delegation since Part 37 is being revoked. No unfavorable comments were received on the proposal. Accordingly, the proposal is adopted without change. However, it should be noted that the current FAA official responsible for TSO's is the Director of Airworthiness.

DISCUSSION OF COMMENTS TO § 21.3

Two commenters pointed out that § 21.3 contained most of the requirements of proposed § 21.617 and suggested deleting requirements in proposed § 21.617 that are duplicated in § 21.3. The FAA agrees and comments to proposed § 21.617 are discussed under § 21.3. Section 21.617 adopted by this amendment relates to a different subject than that of proposed § 21.617 which is discussed under § 21.617.

One commenter suggested revising proposed § 21.617(a) and (b) to require mechanical reliability reporting of TSO articles (currently required for Parts 121, 127, and 135 operators) for Part 91 operators or owners. The commenters cited greater user awareness of such problems for justification. Because the FAA is currently reviewing the entire mechanical reliability reporting program and the issue will be addressed at a later date, the suggestion was not adopted.

Another commenter asked if imported articles would be exempt from the reporting requirements of proposed § 21.617. Section 21.3(d)(2) does exempt foreign manufacturers from the reporting requirements of § 21.3(a) because there are existing means by which the FAA obtains the necessary information from the appropriate airworthiness authorities in the country of manufacture. As a result of the information provided by the foreign authorities, it is not necessary to apply the requirements of § 21.3(a) to foreign manufacturers.

Another commenter suggested removing the phrase "After January 3, 1971" from proposed § 21.617(a) and (b). Based on these comments and upon further consideration, the FAA has amended § 21.3(a), (b), (d), and (e)(3)(ii) to make them applicable to holders of a TSO authorization, relocated proposed § 21.617(f) to new § 21.3(f), deleted the phrase "After January 3, 1971," from § 21.3(a) and (b), and deleted proposed § 21.617.

DISCUSSION OF COMMENTS TO SUBPART O OF PART 21

No unfavorable comments were received on the proposal to amend § 21.305(b) or on proposed §§ 21.609, 21.611, 21.613, 21.615, 21.619, and 21.621. Accordingly, these proposals are adopted without substantive change.

One commenter suggested deleting § 21.305(d) and amending § 43.7 to specify that any alteration or major repair approvals granted under Part 43 be limited to the specific aircraft (by type and serial number) upon which work is performed. The commenter stated that the provisions of § 21.305(d) in conjunction with discretionary functions of § 43.7 would "administratively lead to arbitrary and capricious application of subjective standards." No proposal was made in Notice 79-15 to amend §§ 21.305(d) and 43.7 as suggested by the commenter. Furthermore, since the FAA does not have sufficient information at the present time to justify such amendments to §§ 21.305(d) and 43.7, the suggestion is not adopted.

One commenter suggested placing the TSO procedural requirements under Subpart K instead of proposed Subpart O and questioned the need for the proposed new Subpart O. Relocation of the procedural requirements of Subpart A of Part 37 in new Subpart O, as proposed, would retain the same paragraph format subdivisions which are easy to read and use. This would make the regulations easier to use for all members of the public. Therefore, these requirements are relocated in Subpart O.

One commenter suggested that TSO authorizations be transferable. The FAA does not agree. TSO authorizations are not transferable like type certificates because authorizations are issued based on the person's quality control system and ability to duplicate the article under the TSO system.

§ 21.601

No unfavorable comments were received on proposed § 21.601. However, the FAA is adopting an amendment to § 21.601 by adding paragraph 21.601(c) which states that the Administrator does not issue a TSO authorization if the manufacturing facilities for the product are located outside of the United States, unless the Administrator finds that the location places no undue burden on the FAA in administering applicable airworthiness requirements. This additional requirement is necessary to ensure that proper surveillance can be maintained over the manufacturer's facilities. The need to impose this restriction is based upon the type of surveillance necessary over a manufacturer having a TSO authorization. It is identical to the restriction placed upon manufacturing facilities to which type certificates are issued in accordance with § 21.43 and to which production certificates are issued in accordance with § 21.137 and reflects current practice. A new § 21.617 is adopted to address current practices for approving foreign-manufactured articles designed to TSO performance standards. The procedures of new § 21.617 provide an equivalent to the domestic TSO authorization.

§ 21.603

One commenter objected to proposed § 21.603(b) which continues to allow the holder of an FAA letter of acceptance of a statement of conformance, issued for an article before July 1, 1962, to continue to manufacture that article without obtaining a TSO authorization. The commenter stated that this establishes different levels of safety for the same product because it allows a product to continue to be manufactured under obsolete standards when that product could not meet current standards. Holders of such letters must comply with the requirements of §§ 21.607 through 21.615, 21.619, and 21.621. In general, when an application for TSO authorization is made, the applicable standards for the article are those in effect on the date of application. The FAA did not propose to revise § 21.603(b) to withdraw letters of acceptance issued before July 1, 1962, or any TSO authorization issued after July 1, 1962, and to require all manufacturers to demonstrate compliance with the current TSO performance standards. No unfavorable comments were received on the proposal to relocate the substance of § 37.3 to new § 21.603. Accordingly, the proposal is adopted without substantive change.

§ 21.605

One commenter recommended revising proposed § 21.605 (a)(2) to require one copy of the technical data required in the applicable TSO issued by the Administrator unless additional copies are requested by the Administrator. The FAA agrees this would reduce the number of copies of the technical data the applicant would need to submit. Another commenter suggested revising the last sentence of proposed § 21.605(a)(3) to add the phrase "or numbers (or combinations thereof)" between the words "letters" and "will." The commenter stated this would allow the use of suffix numerals as well as letters to designate minor changes to TSO articles. The FAA agrees. After further review, the FAA has determined that the use of part numbers in proposed §§ 21.605(a)(3) and 21.611(a) to identify minor design changes would simplify and expedite approval of such changes. This is consistent with Executive Order 12044 in that it lessens the regulatory burden on the public. Accordingly, § 21.605 is adopted with the noted changes.

§ 21.607

One commenter suggested deleting proposed § 21.607(d)(3) because the required weight information is not necessary as a part of the nameplate and it is provided elsewhere. The FAA agrees. Section 21.607(d)(3) is deleted and § 21.607(d) is renumbered. The same commenter recommended amending proposed § 21.607 to list the required data and information currently listed in the performance standards of each TSO to further simplify the TSO system. The FAA has determined that since the data and information listed in each TSO are not common to all TSO's, the recommendation, if adopted, would impose unnecessary requirements on some TSO authorization holders. Accordingly, proposed § 21.607 is adopted without substantive change.

Issue of Letters of TSO Design Approval: Import Appliances

New § 21.617

In order to implement the requirements contained in §§ 21.601(b)(2), 21.603(d) and 21.609(b), the FAA is adopting procedural requirements which reflect current practice for the issuance of letters of TSO design approval for import appliances (see discussion of § 21.601). New § 21.617, which is totally different in subject from proposed § 21.617 (see § 21.3), prescribes the procedural requirements and, as adopted, §§ 21.601(b)(3), 21.603(a), and 21.609(b) are revised to address foreign manufacturers. These procedural requirements reflect the current practice. Adopting this procedure causes no burden on any person and it has the benefit of formalizing the current practice. The FAA finds that notice and public procedure are unnecessary.

NOTE: This rule contains provisions for the issuance of a TSO authorization and a letter of TSO design approval. To differentiate, a TSO authorization is limited to manufacturers of articles (materials, parts, processes, or appliances) located in the United States. These manufacturers must comply with the requirement to submit quality control system data in addition to certifying that their design complies with the pertinent TSO. Conversely, a letter of TSO design approval is processed under the provisions of airworthiness bilateral agreements and is limited to appliances as defined in pertinent airworthiness bilateral agreements. Such approvals do not require submitting quality control data. The quality control integrity of these appliances is attested to by the Certificate of Airworthiness for Export issued by the civil airworthiness authority of the country of manufacture under the provisions of § 21.502.

NOTE: Any article approved under an FAA TSO authorization (domestic) or under a letter of TSO design approval (foreign) only attests to the conformity of the design and quality of the particular article against the TSO performance and quality control standards. It does not convey an installation approval. Accordingly, installation approval must be obtained in a manner acceptable to the Administrator for each particular product on which the article is to be installed. This is not a change in existing practice.

DISCUSSION OF COMMENTS TO PART 37

One commenter suggested revoking only Subpart B of Part 37. The FAA has determined that there is benefit in having all of the certification procedures for products and parts in Part 21 of the Federal Aviation Regulations. Accordingly, the proposal to revoke Part 37 is adopted without change.

NOTE: There is no change in reporting and/or recordkeeping requirements which are relocated from Subpart A of Part 37 to new Subpart O of Part 21.

ADOPTION OF THE AMENDMENTS

Accordingly, Parts 11, 21, 25, 29, 37, 91, 121, 127, and 135 of the Federal Aviation Regulations (14 CFR Parts 11, 21, 25, 29, 37, 91, 121, 127, and 135) are amended, effective September 9, 1980.

(Sections 303(d), 313(a), 601, 603, and 605, Federal Aviation Act of 1958, as amended (49 U.S.C. 1344, 1354(a), 1421, 1423, 1424, and 1425; Section 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE: The FAA has determined that this document involves regulations which are not considered to be significant under the procedures and criteria prescribed by Executive Order 12044 and as implemented by the Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979). A copy of the final evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Amendment 25-53

Operations Review Program: Amendment No. 8

Adopted: June 16, 1980 **Effective: August 31, 1980**

(Published in 45 FR 41586, June 19, 1980)

SUMMARY: These amendments update and improve certain requirements for the certification and operation of domestic, flag, and supplemental air carriers and commercial operators of large aircraft, for the certification and operation of scheduled air carriers with helicopters, and for the airworthiness standards for transport category airplanes. These amendments are part of the Operations Review Program and are based on a compilation of proposals discussed at the Operations Review Conference.

FOR FURTHER INFORMATION CONTACT:

Mr. Norman C. Miller
Regulatory Review Branch, AVS-22
Safety Regulations Staff
Associate Administrator for Aviation Standards
Federal Aviation Administration
800 Independence Avenue, SW.
Washington, D.C. 20591
Telephone: (202) 755-8714

SUPPLEMENTARY INFORMATION:

History

This amendment is issued as part of the Operations Review Program. The following amendments have previously been issued as part of this program:

	Title and Federal Register (FR) Citation
Amendment No. 1:	Clarifying and Editorial Changes (41 FR 47227; October 28, 1976).
Amendment No. 2:	Rotorcraft External-Load Operations (42 FR 24196; May 12, 1977 and 42 FR 32531; June 27, 1977).
Amendment No. 2A:	Special Federal Aviation Regulation No. 36, Development of Major Repair Data (43 FR 3084; January 23, 1978).
Amendment No. 3:	Airspace, Air Traffic, and General Operating Rules (44 FR 15654; March 15, 1979).
Amendment No. 4:	Miscellaneous Amendments (43 FR 22636; May 25, 1978).
Amendment No. 5:	Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft (43 FR 22643; May 25, 1978, 43 FR 28403; June 29, 1978, and 44 FR 25201; April 30, 1979).
Amendment No. 6:	General Operating and Flight Rules and Related Airworthiness Standards and Crewmember Training (43 FR 46230; October 5, 1978).
Amendment No. 10:	Airworthiness, Equipment, and Operating Rules (44 FR 61323; October 25, 1979).

These amendments are based on three Notices of Proposed Rule Making: Notice 78-7 (43 FR 20448; May 11, 1978), Notice 78-7A (43 FR 33158; August 10, 1978), and Notice 75-31 (40 FR 29410; July 11, 1975). Interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review by the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notices 78-7, 78-7A, and 75-31. Several comments were received which discussed matters not proposed in the Notice.

These comments are beyond the scope of the Notice and cannot be considered without further notice and public participation.

Discussion of Comments

Airworthiness Review Program

The proposal to add a new § 25.819 (Proposal 8-40) was deferred from Airworthiness Review Program Amendment No. 8, Cabin Safety and Flight Attendant Amendments, and is included in this amendment with other cabin safety rules.

New § 25.819 establishes a level of safety for occupants of lower deck service compartments equivalent to that now provided for occupants of the main deck. To do this, § 25.819 requires several things: (1) two emergency evacuation routes (one at each end of each lower deck service compartment or two having sufficient separation within the compartment); (2) automatic emergency illumination for each lower deck service compartment; (3) two-way voice communication between the flight deck and each lower deck service compartment; and (4) an emergency alarm system and a public address system. Specific safety requirements are adopted for the powered lift system and for other safety related features. The rule provides design requirements that assume occupancy of the lower deck service compartment during taxi and flight. Under § 25.819, occupancy of the compartment is not allowed during takeoff or landing.

Several wide-body airplanes have lower deck service compartments, located below the main cabin, which are used during flight for food service. One operator uses the compartment during taxi, but not during takeoff or landing. This amendment provides design criteria that would allow all operators to use the compartment during taxi if certain strict safety design standards are met during the certification process.

A commenter suggests that the heading of § 25.819 include the term "galley" because that word (with the words "service compartment") is used in the text. The term "service compartment" includes a galley, but for clarity, the parenthetical phrase "(including galleys)" is added to the heading of § 25.819 and the word "galley" is deleted in the text of § 25.819.

A commenter suggests that § 25.819 should apply to airplanes having a service compartment that is located above (as well as below) the main deck. Section 25.819 addresses the unique aspects of lower deck service compartments. Existing rules are adequate for the safe design of other service compartments.

Several commenters object to allowing (in the lead-in sentence of § 25.819) occupancy of the lower deck service compartments "during taxi." They contend that flight attendant occupants of these compartments during taxi are subject to injury because they cannot see outside the compartment and they may not be able to evacuate the compartment if an accident occurs. The provisions of § 25.819 are specifically designed to warn occupants of any emergency and to ensure their safe evacuation to the main deck. As part of the warning system, the rule requires a two-way voice communication system, an emergency alarm system, and a public address system. Main deck flight attendants cannot always see outside and the FAA is unaware of data which shows a correlation between the ability to see outside and the potential for flight attendant injury. To assure that occupants of the lower deck service compartment can get out in an emergency, § 25.819(a) is changed and requires two emergency evacuation routes (one at each end of each lower deck service compartment or two having sufficient separation within the compartment) which can be used under normal and emergency lighting conditions.

Several commenters contend that flight attendants should be stationed on the main deck during taxi operation so they are available to perform safety functions if an accident occurs. New § 121.391 (see the discussion of proposal 8-4) provides that required flight attendants remain seated at their assigned station during taxi except to perform safety related functions. Thus, flight attendants in the lower deck during taxi would not affect the demonstrated emergency evacuation of the airplane.

A commenter recommends that § 25.819(a) include a requirement that the evacuation escape route be designed to minimize the possibility of blockage which might result from "persons standing on top of or against escape routes." The possible blockage of evacuation escape routes (hatches and other cabin openings) by persons standing on top of or against them is examined during airplane type certification. The comment has merit and § 25.819(a) is revised to include this recommendation as a design requirement.

A commenter suggests that § 25.819(b) be revised by substituting the words "a two-way voice communication system to and from" for the words "two-way voice communication between," to clarify the need for communication between occupants of the various compartments covered. The language in § 25.819(b) is clear in this respect.

Two commenters suggest clarification of the term "emergency alarm system" in § 25.819(c). They observe that this term could be interpreted to call for a visible signal, an audible signal, or even an intercommunication system. The comment has merit and § 25.819(c) is revised to require an aural emergency alarm system. A commenter suggests that the emergency alarm system in § 25.819(c) should be "suitable for inflight audibility" at all required locations. This comment has merit and § 25.819(c) is revised to require that the aural emergency alarm system be audible during normal and emergency conditions.

A commenter suggests that there might be some overlap between § 25.819(b) and Proposal 7-45 in Airworthiness Review Notice No. 7 (40 FR 24810; June 10, 1975). Section 25.819(b) deals with emergency evacuation of lower deck service compartments to the main passenger deck. Proposal 7-45 deals with emergency evacuation of passenger compartments. Thus, there is no overlap.

A commenter points out that on wide-body airplanes there are frequently more flight attendant seats than the required number of flight attendants. The commenter suggests the word "required" should be inserted before the phrase "main deck flight attendant stations" in § 25.819(c). In response to this comment, the amendment is changed to read "require floor level exit" instead of "main deck flight attendant stations". This change will provide an adequate aural emergency alarm system to alert occupants of each lower deck service compartment, by requiring that an aural emergency alarm system be located at each required floor level emergency exit. Since new § 121.391 provides that required flight attendants remain seated at their assigned stations during taxi, locating the alarm systems at required floor level emergency exits will insure that they are readily available to required flight attendants to alert occupants of lower deck service compartments if an emergency occurs.

A commenter suggests that the emergency alarm system described in § 25.819(c) should require that crew occupants of each compartment be capable of alerting crew occupants of each other compartment that an emergency condition exists. This requirement was proposed as Proposal 7-53 in Airworthiness Review Notice No. 7 (40 FR 24812; June 10, 1975). In Airworthiness Review Amendment No. 7 (43 FR 50578; October 30, 1978), that proposal was withdrawn because there was not enough information to specify intercommunication equipment requirements appropriate for all transport category airplanes.

Another commenter asks whether the emergency alarm system described in § 25.819(c) should be connected to the electrical system emergency bus bar. The emergency bus bar is reserved for those electrical loads essential for safe flight and landing if a power interruption occurs. The emergency alarm system is not essential for safe flight and landing under emergency conditions. The alarm system should not be connected to the emergency bus bar.

A commenter recommends that § 25.819(d) be revised to require a means readily detectable by occupants of upper, main, and lower deck service compartments to indicate when seat belts should be fastened. This is unnecessary. Present § 25.791 requires passenger information signs in all passenger compartments. Section 25.819(d) requires the same signs in the lower service compartment.

A commenter suggests that § 25.819(e) require that a public address system be installed with speakers suitable for inflight audibility. Section 121.318 requires a public address system for airplanes engaged in passenger operations under Part 121. Under

§ 121.318(b)(4), this public address system must be audible at each flight attendant seat. Requiring the installation of the public address system as a condition for type certification under Part 25 is inappropriate since some of the certificated airplanes will not be operated in passenger operations under Part 121. Thus, Part 121 all-cargo operators and persons who do not operate under Part 121 would be required to bear the cost of an expensive installation that is not required for their operation.

A commenter points out that, since the lower deck service compartment would not be occupied during takeoff and landing, the seat prescribed in § 25.819(f) need not be limited to forward or aft facing. The FAA issued an Airworthiness Directive on February 23, 1976 (41 FR 8766) which stated that injuries have been experienced in sideward facing seats during relatively mild incidents of turbulence. Since the seat may be occupied during flight, safety of the occupant requires that the seat be forward or aft facing and meet the requirements of § 25.785(c). The commenter also states that the seat should only be designed to flight loads, and to loads that might occur during taxi, rather than to the emergency landing loads of § 25.561. Since § 25.785(a) applies only to seats that may be occupied during takeoff and landing, the seats prescribed by § 25.819(f) need not comply with the emergency landing conditions specified in § 25.561, but must be able to withstand maximum flight loads when occupied.

Another commenter suggests that § 25.819(f) be revised to require that both supplemental and portable oxygen systems be immediately available to each occupant of the lower deck service compartment. Section 25.1447(c)(4) requires that portable oxygen equipment must be immediately available for each cabin attendant. Section 25.1447 also contains oxygen system requirements that apply to all occupants, wherever located on the airplane. These rules are sufficient.

One commenter objects to the phrase "if the lift is occupied" in § 25.819(g)(1) stating that the language obviously implies occupancy by a person. The commenter asks how the lift knows whether it is occupied by a person or a cart. To design a system to distinguish between a person and a cart would unnecessarily complicate the design of the lift control system. The commenter further states that the rule would also prohibit the operation of an empty lift. The commenter's points are valid and the phrase "if the lift is occupied" is deleted from § 25.819(g)(1).

In response to another commenter, the control switch must prevent activation of the lift if either the hatch in § 25.819(g)(4) or the lift door in § 25.819(g)(1) or both are open. Section 25.819 is revised to make this clear.

A commenter objects to § 25.819(g)(2) as unclear. The commenter contends that the requirement to provide an alternate method of operating the lift (after failure of its primary power source) would unnecessarily complicate the system. Section 25.819(g)(3) requires an alternate means for evacuating persons from an inoperative lift, with the lift in any position. Accordingly, proposed § 25.819(g)(2) is withdrawn, and proposed §§ 25.819(g)(3) and (g)(4) are redesignated §§ 25.819(g)(2) and (g)(3), respectively.

A commenter suggests that the words "evacuating persons from the lift" in § 25.819(g)(3) be replaced with the words "evacuation which is of the size and shape to safely remove persons from the lift." The suggested language would not add to or improve the requirement.

Concurrently with this amendment, the FAA is issuing Operations Review Notice No. 8A for reasons explained in the preamble of that Notice. The Notice proposes that all flight attendants remain seated during taxi, except to perform duties related to the safety of the airplane and its occupants. The Notice also requests commenters to submit specific data on flight attendant injuries during taxi. If the proposal in the Notice is adopted as proposed, operations requiring occupancy of the lower lobe during taxi as allowed under new § 25.891 may be severely limited.

Public Address System

Amendment 25-46 (43 FR 50578; October 30, 1978) amended § 25.1411 to require at least one public address system microphone intended for flight attendant use to be positioned at each floor level exit and to be readily accessible to a flight attendant seated in any seat adjacent to that exit. Amendment No. 121-149 (43 FR 50578; October 30, 1978) amended § 121.318 to require compliance, after December 1, 1980, with the new public address system microphone requirements.

Since publication of Amendments 25-46 and 121-149, it has come to the attention of the FAA that these rules inadvertently failed to refer to only required floor level exits. Sections 25.1411(a)(2) and 121.318(b)(2) are revised to provide that each public address system microphone intended for flight attendant use must be positioned adjacent to a flight attendant seat that is located near each required floor level emergency exit in the passenger compartment and be readily accessible to the seated flight attendant.

Amendment 121-149 allows a compliance date of 2 years, until December 1, 1980, for installation of the public address system. Approximately 18 months have passed since the issuance of the amendment, during which the operators have not fully complied with Amendment 121-149 because of the ambiguity in the rule. Recognizing that the operators have already initiated compliance with the rule, the compliance date for § 121.318(b)(2) is extended 1 year to December 1, 1981, to allow the intended 2-year compliance period.

With these amendments, §§ 25.1411(a)(2) and 121.313(b)(2) continue to require: (1) installation of a public address system microphone at a seat located near each floor level exit that is designated for use by a required flight attendant; (2) that only one public address system microphone need be installed for arrangements in which more than one required flight attendant is seated near the same required floor level exit; and (3) that the public address system microphone need not be usable by the required flight attendant while standing next to a required floor level exit.

Since these amendments are clarifying in nature and do not impose a burden on the public, notice and public procedure are unnecessary and these changes are adopted as noted.

Operations Review Program

The following discussions are keyed to like-numbered proposals contained in Notice 78-7.

Proposal 8-1. No unfavorable comments were received on § 121.177(b) that requires corrections to be made for the effective runway gradient when determining takeoff limitations. Section 121.177(b) is adopted without substantive change.

Proposal 8-2. This proposed revision of § 121.311(b) would require passengers to have their seat belts fastened during flight time and allow them to leave their seats only for physiological needs or when authorized by a crewmember. The majority of the many commenters strongly oppose what they consider unnecessary regulatory restrictions on passengers. Many believe that a passenger should retain the right to decide whether or not to fasten the seat belt after being properly informed of potential risks involved. Several commenters support the requirement to keep the seat belt fastened while seated but object to requiring a passenger to obtain a crewmember's permission to leave the seat. Many commenters point out that they customarily keep their seat belt fastened while seated. Others state that adoption of this regulation would dilute the present procedure for mandatory fastening of seat belts (such as on landing, takeoff, or when flying through turbulent air) and would result in confusion and possible compromise of safety.

In light of these comments, the FAA has determined that current §§ 121.571(a)(2) and 121.317(b) provide sufficient advisory information to the passengers. Executive Order 12044 and the Department of Transportation Regulatory Policies and Procedures are intended to reduce unnecessary burdens on the public. Accordingly, the FAA concludes that this rule would impose unnecessary burdens on passengers, industry, and the FAA not commensurate with an increase in safety. Accordingly, the proposal to amend § 121.311(b) is withdrawn. A proposal to amend § 127.109 in a similar manner (Proposal 8-23) is withdrawn for the same reasons.

Proposal 8-3. Several commenters favor § 121.317(b) which requires that a fasten seat belt sign be affixed to each seat back as a reminder to passengers to fasten their seat belts when they return to their seats.

One commenter objects and states that if § 121.317(b) means that passengers should remain in their seats with seat belts fastened at all times, then leaving the present seat belt sign lighted at all times would accomplish that end. The sign required by § 121.317(b) reminds passengers to fasten their seat belts when they return to their seats. The present seat belt sign is used during landings, takeoffs, turbulent air, or emergency conditions and passengers must remain in their seats and fasten their seat belts when that sign is used.

Another commenter objects to the cost of installing the signs, to the lack of specifications for installing them, and to the passenger confusion that would result in trying to comply with two fasten seat belt signs (the lighted sign and the seat back sign). The signs will enhance safety by reducing injuries from inflight turbulence. This offsets any minimal increase in cost. Specifications were not proposed to allow operators maximum flexibility in designing and installing the signs. Passenger confusion would be reduced because the briefing required by § 121.571(a) will include an explanation to passengers of the purpose of both signs. The proposal is adopted without substantive change.

None of the comments received addressed the time needed to comply with § 121.317(b). Under this requirement, the certificate holder must install a sign for each passenger seat. There are more than 3,250 airplanes operated under Part 121 with an average seating configuration in excess of 100 seats. The FAA estimates that it will take several months to design and obtain the over 325,000 signs needed to comply with the rule. Based on the number of seats and airplanes involved, the FAA estimates that installation of the signs will take several more months. The required installations can be accomplished during routine scheduled maintenance. Based on these facts, the FAA concludes that 1 year is needed to comply with § 121.317(b) and that section takes effect 1 year after the effective date of these amendments.

The amendment to § 127.115 (Proposal 8-24) is adopted for the same reasons.

Proposal 8-4. Section 121.391(d) requires flight attendants, required by Part 121, to be seated with seat belts and shoulder harnesses fastened during taxi except to perform safety related duties. The majority of the commenters favor adoption of § 121.391(d). Their reasons include personal safety of flight attendants, flight attendant availability at duty locations during emergencies requiring evacuation, and passenger reaction to observing flight attendants moving freely about the cabin. Many flight attendants cite injuries occurring when they are thrown about the cabin during sudden turns or stops while taxiing. One commenter objects to allowing flight attendants to perform duties related to safety since that may be harmful to the flight attendants' personal safety. This objector fails to recognize that the duties enumerated are essential to passenger safety. Flight attendants must brief passengers to ensure their safe evacuation as well as perform other safety-related functions.

Three commenters object to § 121.391(d). Based on limited research, one commenter could find no instance of passenger fatalities or serious injuries during taxi. A search of FAA accident/incident records and NTSB files for a 7-year period shows 18 instances of airplane evacuation during taxi which resulted in 71 passenger and 4 flight attendant injuries. As an example, a flight attendant was thrown down the stairs and hospitalized for at least 48 hours by a sudden stop of a Boeing 747 airplane while taxiing for takeoff in Honolulu, Hawaii, on February 2, 1980. One commenter states that flight attendants receive adequate notice to enable them to return to their required stations before an emergency evacuation. However, notice cannot always be provided and if the flight attendant is not at the station when an emergency occurs, precious seconds may be lost during an evacuation.

This commenter also says that the rule is vague as to what safety related duties are. Duties related to the safety of the airplane and its occupants include the checking of seat belts and seat backs, preflight briefings, directing an emergency evacuation, responding to a cabin emergency, or aiding a passenger or crewmember who requires emergency assistance.

This commenter also points out that the rule makes it virtually impossible to offer the passengers any form of refreshment service while on the ground. Requiring flight attendants to be seated during taxi may result in a reduction of refreshment service. The safety benefits of having the required flight attendants at their assigned stations and ready to execute an emergency evacuation far outweigh the customer service benefits derived from early refreshment service. Also, refreshment service is not allowed during takeoff and landing because of its possible impact on safe evacuation if an emergency occurs. Another commenter states that a flight attendant moving through the aisle and returning passenger belongings during taxi-in helps ensure that passengers remain in their seats. Although this comment may have some merit, the overall safety of passengers and flight attendants is more important than the possible benefit to be received by allowing required flight attendants to return passenger belongings during taxi.

In printing the text of the proposed sentence to be added to § 121.391(d), the FEDERAL REGISTER inadvertently changed the wording proposed by the FAA and documented in public docket number 17897. As published in the FEDERAL REGISTER, the sentence began: "During taxi, required by this section, flight attendants must. . . ." As transmitted to the FEDERAL REGISTER, the sentence began: "During taxi, each flight attendant required by this section must. . . ." The language the FAA proposed would impose the rule on required flight attendants only. As adopted, the sentence reflects the original language that FAA proposed.

Section 121.391(d) as already noted is based upon FAA accident/incident records and NTSB files that include 18 emergency evacuations during taxi over a 7-year period which resulted in 71 passenger and 4 flight attendant injuries. When conducting the emergency evacuation demonstration required under § 121.291(a) for a particular airplane, a required number of flight attendants is established. Section 121.397 specifies that the required crewmembers, which includes flight attendants, be assigned functions to be performed in an emergency evacuation. If an evacuation is necessary because of an emergency during taxi it is important that the required flight attendants be seated at their assigned duty stations to assist in the evacuation. Should they be up and injured or unable to reach their assigned station by passengers blocking the aisle, the time required to evacuate the airplane could be increased, the evacuation process itself possibly impeded, and passengers and crewmembers subjected to a higher probability of injury. For this reason, § 121.391(d) applies to required flight attendants who must be seated at their duty station during taxi and be able to perform their safety related duties if necessary. Thus, § 121.391(d) is adopted with the typographical errors corrected.

Concurrently with this amendment, the FAA is issuing Operations Review Notice No. 8A for reasons explained in the preamble to that Notice. The Notice proposed to extend applicability of § 121.391(d) to all flight attendants by requiring that they remain seated during taxi, except to perform duties related to safety. The Notice also requests commenters to submit specific data on injuries to flight attendants.

Proposal 8-5. Several commenters object to the words "except for length" in § 121.434(e). They argue that cabin training devices should simulate actual cabin length so flight attendant trainees experience proper distance to emergency exits under simulated emergency conditions. Some commenters want to add the word "realistic" following "full-scale" to assure the certificate holder provides adequate training. Simulated cabin training realistically duplicates the actual cabin training and is equivalent to or better than the training that is received in an actual airplane. Before the FAA approves a training program, the certificate holder must show that the device realistically duplicates cabin duties and emergencies. Therefore, the suggested changes are not made.

One commenter wants to include training time accomplished in a parked aircraft to reduce flight attendant operating experience under § 121.434(e). A parked aircraft may be used as a training device if approved as part of the training program, but that is no substitute for experience gained in a line operation. Another commenter wants to reduce flight attendant operating experience based upon the number of additional takeoffs and landings (as for flight crewmembers). Based on experience gained under § 121.434(e), the FAA has determined that the present requirement of 5 hours of operating experience in an airplane and the proposed revision to allow the substitution of 50 percent of the operating experience for training conducted in an approved training device, is the minimum requirement for flight attendants.

Proposed § 121.434(e) should have used the words "training device"rather than "simulator." Accordingly, § 121.434(e) is adopted with this change.

Proposal 8-6. Several commenters object to § 121.441(a) because pilots qualified and serving in more than one type of airplane would have to complete an unnecessary number of qualifying proficiency checks and simulator training courses. The intent of the proposal was to clarify that the proficiency check requirements of § 121.441 should not be fulfilled in an airplane other than the type in which the person is to serve. However, if adopted as proposed, § 121.441 would require a pilot in command qualified in more than one type airplane to take a proficiency check and a simulator course of training in each type of airplane during a 12-month period. The FAA did not intend to place these additional requirements on a pilot in command qualified in more than one type of airplane and the current rule adequately ensures safety of flight. The elimination of this unnecessary proposal is consistent with Executive Order 12044 and the Department of Transportation Regulatory Policies and Procedures which are intended to reduce unnecessary burdens on the public. The FAA concludes that § 121.441(a) would impose burdens not commensurate with the increase in safety and § 121.441(a) is withdrawn.

Proposal 8-7. No unfavorable comments were received on the proposal to revise § 121.443, except one objection to § 121.443(b). The commenter claims that the word "ensures" is unnecessary and is subject to misinterpretation. The commenter argues that airlines accept full responsibility by providing crew training and appropriate information for flight operations. Thus, there should be no requirement to ensure knowledge and the ability to use that knowledge. The certificate holder is responsible for the training program. The certificate holder also is responsible (through that training program) to ensure that the pilot in command has adequate knowledge of, and the ability to use, the information provided for the flight.

The commenter also suggests deleting "holding procedures" in § 121.443(b)(6) and "Notices to Airmen" in § 121.443(b)(8). Information on holding procedures and notices to airmen must be provided to ensure that the pilot in command has all available information necessary for the safety of each flight. Finally, the commenter suggests substituting "appropriate" for "all" in § 121.443(b)(6). The word "authorized" better describes the instrument approach procedures that must be provided under § 121.443(b)(6). The word "all" could require that information to be provided on procedures which are unnecessary. Section 121.433(b)(6) is revised by substituting "authorized" for the word "all."

Proposal 8-8. One commenter wants § 121.445(b)(2) changed to allow the use of "other" than pictorial means, but does not say what they are. Without a specific alternative, the FAA cannot evaluate this comment. This commenter also states that the ceiling requirements of § 121.445(c) are not specific enough and need clarification. The commenter suggests that the "altitude prescribed for the instrument approach" means the "initial approach altitude." The comment has merit and the words "initial approach altitude" are used in § 121.445(c).

The commenter also has difficulty with the "special area" qualification in § 121.445(d) which requires either a qualification flight or approved training every 12 calendar months. The commenter argues that a pilot who is qualified with the special type of cockpit navigation in one area also is qualified in any other area. This comment has merit and § 121.445(d) is revised to allow a pilot to meet the qualification requirement by using the special type of cockpit navigation over any route or area within the preceding 12 calendar months. In addition, the word "route" is added to "area" so that possible single routes requiring specialized navigation systems are included as well as specific areas (such as the Minimum Navigation Performance Systems over the Atlantic Ocean).

Proposal 8-9. No unfavorable comments were received on deleting § 121.447 on pilot and airport qualifications and the section is deleted.

Proposal 8-10. One commenter objects to § 121.563 because insignificant, non-safety, mechanical irregularities would be entered in the maintenance log book and then "cleared" at both maintenance and nonmaintenance stations, causing increased costs and unnecessary delays. Section 121.153 does not require maintenance log book entries to be cleared any differently than the existing rule does. This rule requires mechanical irregularities to be entered in the maintenance log at the next place of landing. The rule is particularly appropriate with the increasing complexity of aircraft systems and the minimum equipment lists.

The FAA proposed to delete the last sentence of § 121.563 because this requirement is covered in other sections of Part 121. Further study reveals that the requirement for a pilot in command to ascertain the status of the airplane before each flight is not covered elsewhere. Therefore, the last sentence is not deleted from § 121.563 as proposed.

Proposal 8-11. This change to § 121.571(a)(2) proposed to require an announcement after takeoff that all passengers must keep their seat belts fastened as required by Proposal 8-2. Since Proposal 8-2 is withdrawn, this proposal also is withdrawn.

Proposal 8-12. No unfavorable comments were received on § 121.574(a)(4) requiring the written statement of medical need by the doctor to be kept in the possession of the person using the oxygen equipment. It is adopted as proposed.

Several commenters object to changing § 121.574(b) because the current minimum distance of 10 feet between a person who is smoking and a person using oxygen is adequate. Another commenter suggests that the distance be reduced. After review of the comments and a reexamination of this proposal, the FAA concludes that the current rule should be retained. The proposal is confusing and would be difficult to enforce. The definition of a row is not uniform and the distances are not readily measurable. The proposal to amend § 121.574(b) is withdrawn.

Proposal 8-13. Proposed § 121.579 would have revised the rules for minimum altitudes for the use of autopilots in approaches. Comments received from the Airline Pilots Association and Civil Aviation Authority of England on proposed § 121.579(b) reflect inconsistencies between the existing rule and supporting documents (Advisory Circular 25.1329-1A and Agency Order 8110.8) which proposed § 121.579(b) does not resolve. The comments received consisted of 24 pages of technical evaluations of the present rule, proposed rule, and Advisory Circular 25.1329-1A. After a thorough review of the submitted material the FAA concludes that the commenters are correct and that a further review of the present operational and certification criteria is necessary to correct the problems and accordingly proposed § 121.579(b) is withdrawn.

Proposal 8-14. No unfavorable comments were received on § 121.583(a)(4)(iii) regarding the safe handling of hazardous materials and it is adopted without substantive change.

Proposal 8-15. Several commenters favor § 121.589. Many are flight attendants who deal directly with the problem associated with carry-on baggage on aircraft. They cite instances of being forced to stow baggage which cannot be properly stowed. This is because boarding agents allow passengers to board the aircraft carrying this baggage. These commenters also state that passengers who carry their baggage aboard often become irate and troublesome when a flight attendant attempts to take their baggage and stow it properly. The commenters argue that lack of adequate regulatory requirements puts the flight attendants in a position of opposing the passenger, the company, and the boarding agent when they try to deal with the baggage. Properly stowed baggage is important to safe emergency evacuation, and the burden of compliance more appropriately rests on the certificate holder.

One commenter suggests that certain articles of clothing in garment bags be allowed in open overhead racks. These bags cannot be allowed in open overhead racks because of the potential hazard from heavy or sharp items on or in the garment bags. Section

121.589(b) allows these articles to be stowed overhead if the overhead rack has approved restraining devices or doors.

One commenter objects to § 121.589(d) regarding sideward restraint of under seat baggage because it is unnecessary. The commenter argues standard airline operating procedures are effective. Current airline standard operating procedures are not effective. This is reflected in the comments of flight attendants who deal directly with carry-on baggage. Section 121.589(a) prevents baggage from coming aboard if it cannot be properly stowed. Sections 121.589(b) and (d) require that carry-on baggage be prevented from becoming dislodged from overhead racks and underseat stowage areas during hard or crash landings and inflicting injuries to passengers or hampering the emergency evacuation of the aircraft. Section 121.589(c) requires passengers to comply with crewmember instructions concerning stowage of carry-on baggage. Passengers who fail to comply with these instructions are subject to a civil penalty. This rule lessens the number of problems crewmembers face and enables them to concentrate on their safety-related duties.

The commenter also objects to the high cost impact on the certificate holders and submits estimated aisle seat installation cost data for 17 airlines which vary from $21.00 to $150.40 for each aisle seat. The two largest operators' estimates indicate a cost of $25.75 and $31.50 for each aisle seat. These estimates are more in line with the FAA estimate of $30.00 for each aisle seat. In view of these figures, the cost is not considered to be significant in comparison to the resulting safety benefits.

One commenter points out that § 121.589(d) requires a sideward restraint on each passenger seat. Sideward restraint now is provided on most non-aisle seats by the seat track attachments. Section 121.589 is changed to require sideward restraint only on each aisle seat.

Two commenters object to § 121.589(d) because an adequate period of time was not proposed to allow for the installation of sideward restraints. The Air Transport Association of America and Delta Airlines submitted data to support their contention that from 4 months to 7 years are needed to comply with the rule without special scheduling. Under § 121.589(d), the certificate holder must install sideward restraints on each aisle seat. For the 17 airlines on which data was submitted, over 71,000 seats are involved. Based on the data submitted, the FAA estimates that it will take up to 1 year to design, test and obtain the over 71,000 sideward restraints needed to comply with the rule. The commenter submitted no data to support the contention that it would need 7 years to comply and the FAA concludes that a 7-year compliance period is not realistic. The data does indicate a 2- to 3-year period is an appropriate time to complete these installations. Based on all of the comments received, the FAA concludes that a 3-year compliance period will allow time for installation of sideward restraints on aisle seats with little, if any, special scheduling. A shorter compliance time would require inordinate special scheduling and result in higher costs which are not commensurate with the incremental advance in safety that would result. Accordingly, § 121.589(d) takes effect 3 years after the effective date of these amendments.

Proposals 8-16 and 8-17. These changes reduce the 2-hour weather requirement for alternate airports to 1 hour. They also change the ceiling requirement of 1,000 feet above the MEA or MOCA to 1,500 feet above the MDA, if a circling approach is required and authorized, or 1,500 feet above the lowest published minimums or 2,000 feet above the airport elevation, whichever is higher.

Three commenters favor § 121.619. However, they object to any visibility increase beyond the present 3-mile requirement and state that the phrase "or 2 miles more than the lowest applicable visibility minimums, whichever is greater, for the instrument approach procedure to be used at the destination airport" would, at times, require a visibility greater than 3 miles. They consider this too restrictive. Section 121.619 satisfies this objection.

One commenter wants to reduce the visibility minimum to 2 miles. Three miles visibility is considered the minimum acceptable requirement since the aircraft could be operated under visual flight rules in accordance with § 91.105 if 3 miles or greater visibility existed.

One commenter objects to reducing the forecast time period from 2 hours to 1 hour before and after the estimated time of arrival because present weather forecasting capabilities are not precise enough to provide an acceptable prognosis within those time limits. The proposed time limit is sufficient since the pilot in command, under §§ 121.601 and 121.603, is provided with updated weather data en route.

One commenter objects to the deletion of the word "or" following § 121.621(a)(1). This would remove the air carrier's option to operate under the provision of either § 121.621(a)(1) or § 121.621(a)(2) as presently provided in the rule. There is no need to meet both requirements and § 121.621(a) retains the word "or" to preserve the option. The same commenter also notes that present § 121.621(a)(2) incorrectly refers to § 121.645(b). The correct reference is § 121.645(c).

A substantively identical proposal was made in Operations Review Notice No. 6 (42 FR 44205; September 1, 1977) for § 91.23, fuel requirements for flight in IFR conditions. In Operations Review Amendment No. 6 (43 FR 46230; October 5, 1978), § 91.23 was amended to reduce the weather requirements to 1 hour before and after the estimated time of arrival and required a ceiling of at least 2,000 feet above the airport elevation and a visibility of at least 3 miles. Commenters to Notice No. 6 argued that the proposed rule was simpler than the current rule but was still cumbersome. They suggested it would be much simpler if criteria were established which would require the pilot to determine only that a certain ceiling and visibility would exist. The FAA, in adopting Amendment No. 6, agreed with the comments and is aware of no adverse effects of the new rule.

At the time changes to §§ 91.23, 121.619, and 121.621 were proposed in Operations Review Notice Nos. 6 and 8, the FAA intended that, eventually, all three sections would be substantively identical. A review of the airport approach minimums shows that this intent can be safely realized for domestic operations under §§ 91.23 and 121.619. The FAA has not determined that the requirement for a 1,500 foot ceiling above the lowest circling MDA or published minimum approach or a visibility of 2 miles more than the lowest applicable visibility minimum (proposed in Operations Review Notice No. 8) can be safely deleted for flag air carrier operations under § 121.621. Accordingly, § 121.619(a) is adopted with the changes noted and § 121.621(a) is adopted as proposed.

Proposal 8-18. For comments relating to the deletion of § 121.691 see Proposal 8-19. Section 121.691 is deleted and the section marked "reserved."

Proposal 8-19. Several commenters object to § 121.693(e) on the grounds that scheduled air carriers would suffer unnecessary administrative and economic burdens with no significant increase in safety. They claim that air travel is the only mode of transportation which requires names of passengers and indicate that the requirement may be an invasion of the privacy of the traveling public. They were particularly against requiring the addresses of passengers. The names of passengers are necessary for identification purposes in case of an accident or other emergency situations. The nature of aircraft accidents is such that other means of identification may not be feasible. A requirement to obtain the addresses of passengers may be an unnecessary burden on certificate holders and is unnecessary for identification purposes. Therefore, § 121.693(e) is revised by deleting the words "and home addresses". One commenter feels that passenger identification would have to be confirmed at the boarding gate to satisfy the requirements of § 121.693(e). Section 121.693(e) only requires use of the name given by each passenger. Accordingly, § 121.693 is adopted with the revisions discussed.

No unfavorable comments were received on combining the load manifest requirements for domestic and flag carriers of § 121.691 with the requirements of § 121.693 for supplemental air carriers and commercial operators. Thus, § 121.691 is deleted and reserved.

Proposal 8-20. No unfavorable comments were received on the amendment to Appendix E. However, after reconsideration, the FAA withdraws the proposed amendments to Items III(1)(1) and (2). This change proposed to allow the normal ILS approach with a simulated powerplant failure, the missed approach from an ILS approach, and the missed approach that includes a powerplant failure to be accomplished in a visual simulator during initial training. The FAA is not convinced that all visual simulators currently in use have sufficient capability to fully train initial training candidates in these maneuvers. The FAA proposed in Notice 79-18 (44 FR 65550; November 13, 1979) simulator requirements to accomplish these maneuvers for initial training in a simulator. Therefore, these items of the proposal are withdrawn. The remainder of the changes are adopted as proposed.

Proposal 8-21. No unfavorable comments were received on the proposal to amend Appendix F. However, after further examination, the FAA has concluded that this proposal has several inconsistencies. In most cases, the FAA does not directly observe a pilot during training. The primary means used by the FAA to evaluate a pilot's knowledge and skill is the practical examination conducted under Appendix A of Part 61 or Appendix F of Part 121. The oral examination is an integral part of this evaluation and must be retained to ensure that a pilot has an understanding of the airplane and its systems and that an operator's training program is conveying the required knowledge to the pilot. Therefore, the proposal to delete the equipment examination in Item I(a) under certain conditions is withdrawn.

The proposal to delete the "B" symbol in the "Inflight" column and add it to the "Visual Simulator" column for Item III (c)(2) allows any pilot to perform the ILS approach with a simulated powerplant failure in a visual simulator. Section 121.441 allows the entire proficiency check (other than the initial second in command proficiency check) to be conducted in an approved visual simulator if the pilot performs two landings in the airplane during a line check. This means that all pilots (except for a flight engineer upgrading to a second in command and flying the airplane for the first time) are already allowed to accomplish the ILS approach with a simulated powerplant failure in a visual simulator. Since an upgrading flight engineer may not have piloted an airplane for a number of years, all of the inflight requirements in Appendix F should be retained to assure that the person is capable of performing this maneuver in the airplane.

Deleting the requirement that at least one missed approach must be performed in flight would set a precedent of eliminating the necessity for a pilot flying the actual airplane to completely plan and execute an instrument approach which includes the missed approach procedure.

Accordingly, the proposal to amend Appendix F is withdrawn.

Proposal 8-22. The change to Appendix G of Part 121 would add additional requirements to make it compatible with all long-range navigation systems. One commenter correctly states that present Appendix G, and § 121.355(a) which refers to Appendix G, apply only to doppler radar and inertial navigation systems.

Another commenter states that the change is too specific and limits design. The intent is not to restrict the development of new and improved long-range navigation systems.

Two commenters object to the addition of a requirement in paragraph 5(d) for recurrent training and a line check each 12 calendar months. The intent is to ensure proficiency in the use of the long-range navigation systems by the line check. If performance during this check is unsatisfactory, then recurrent training will be required. The proposal does not make this clear.

Both the proposal and comments received have merit. Although the proposal for Appendix G refers to navigation equipment other than doppler radar and inertial navigation, those systems are not specifically allowed under § 121.355(a). The FAA, in a future Operations Review Notice will propose changes to § 121.355(a) to specifically allow other systems as well as changes to Appendix G. This approach will produce more meaningful criteria.

Accordingly, the proposal to amend Appendix G of Part 121 is withdrawn.

Proposal 8-23. For comments related to the proposal to revise § 127.109(b), see Proposal 8-2. Accordingly, the proposal to revise § 127.109(b) is withdrawn.

Proposal 8-24. For comments relative to new § 127.115(b), see Proposal 8-3. Accordingly, the proposal to add a new § 127.115(b) is adopted without substantive change.

Proposal 8-25. No unfavorable comments were received on new § 127.226. However, after further review and consideration, the FAA has determined that passengers should not be required to fasten their seat belts at all times when they are seated. For related comments see Proposal 8-2. An announcement must be made to alert passengers that they "should" keep their seat belts fastened while seated, even when the "Fasten Seat Belt" sign if off. This is similar to the requirement in § 121.571.

Accordingly, § 127.226 is adopted with the change discussed.

Adoption of The Amendments

Accordingly, Parts 25, 121, and 127 of the Federal Aviation Regulations (14 CFR Parts 25, 121, and 127) are amended, effective August 31, 1980.

(Secs. 313, 314, 601 through 610, Federal Aviation Act of 1958 (49 U.S.C. 1354, 1355, 1421 through 1430); Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)).)

NOTE: The FAA has determined that this document involves a regulation which is not significant under Executive Order 12044, as implemented by Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final evaluation prepared for this document is contained in the docket. A copy of it may be obtained by writing to the individual and address listed in the "For Further Information Contact" paragraph.

Amendment 25-54

Airworthiness Review Program—Amendment No. 8A: Aircraft, Engine, and Propeller Airworthiness, and Procedural Amendments

Adopted: August 27, 1980 **Effective: October 14, 1980**

(Published in 45 FR 60154, September 11, 1980)

SUMMARY: These amendments to the Federal Aviation Regulations update and improve the airworthiness standards applicable to the type certification of aircraft, engines, propellers, related operating rules, and procedural requirements. These amendments are part of the Airworthiness Review Program.

FOR FURTHER INFORMATION CONTACT:

Marvin J. Walker, Regulatory Review Branch, AVS-22
Safety Regulations Staff
Associate Administrator for Aviation Standards
Federal Aviation Administration
800 Independence Avenue, SW
Washington, D.C. 20591
Telephone: (202) 755-8714

SUPPLEMENTARY INFORMATION:

These amendments are the ninth and last in a series of amendments issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this program:

Title and FEDERAL REGISTER (FR) Citation

Amendment No. 1: Form Number and Clarifying Revisions (40 FR 2576; Jan. 14, 1975)
Amendment No. 2: Rotorcraft Anticollision Light Standards (41 FR 5290; Feb. 5, 1976)
Amendment No. 3: Miscellaneous Amendments (41 FR 55454; Dec. 20, 1976)
Amendment No. 4: Powerplant Amendments (42 FR 15034; March 17, 1977)
Amendment No. 5: Equipment and Systems Amendments (42 FR 36960; July 18, 1977)
Amendment No. 6: Flight Amendments (43 FR 2302; Jan. 16, 1978)
Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978)
Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; Feb. 4, 1980)

These amendments are for the most part based on Notice 75-31 which was published in the FEDERAL REGISTER on July 11, 1975 (40 FR 29410), as well as a number of proposals contained in the following notices of proposed rule making: Notice 75-10 (40 FR 10802; March 7, 1975); Notice 75-19 (40 FR 21866; May 19, 1975); and Notice 75-26 (40 FR 24802; June 10, 1975). Amendments based on the latter three notices have already been issued as a part of the Airworthiness Review Program, specifically those titled Miscellaneous Amendments, Powerplant Amendments, and Airframe Amendments, respectively. Final action on certain of the proposals was deferred, however, at the time the amendments were issued as further consideration and review of these proposals was considered necessary. In other cases, final action was deferred so that they could be considered together with related proposals contained in other notices.

Certain proposals identified as Group 2 in Appendix I to Notice 75-31 were deferred to be dealt with in a later notice as a part of the Airworthiness Review Program. These proposals all addressed the concept of periodically updating the certification basis of airplane models in long-term production. Such recertification every five or ten years would be intended to ensure that the level of safety of all airplanes in service keep pace with the current level of safety expectations. The FAA has now determined that these proposals more appropriately should be examined as a separate issue in a future regulatory action. Accordingly, the proposals identified as Group 2 in Appendix 1 to Notice 75-31 are being dropped from the Airworthiness Review Program.

Proposals relating to cabin safety and flight attendants, which are identified in this amendment, were extracted from Notice 75-31 (40 FR 29410; July 11, 1975) and handled on an expedited basis. Those rules were published in the Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. The proposals and comments are discussed below. Substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those contained in Notices 75-10, 75-19, 75-26, and 75-31.

DISCUSSION OF COMMENTS

The following discussions are keyed to the like-numbered proposals contained in Notices 75-10, 75-19, 75-26, and 75-31, and are presented in the same order as the corresponding amendments found in the rules portion of this document.

Proposal 8-1. The proposal to amend § 1.1 in order to transfer the definitions for rated power and thrust to a new § 33.6 is withdrawn. It is considered that such a change may introduce confusion in the administration of aircraft certification rules. See also Proposal 8-94.

Proposal 8-2. Several commenters object to proposed § 21.16(a) which would delete reference to a "novel and unusual design feature" as a necessary condition for the Administrator to issue special conditions. Special conditions become a part of the designated applicable regulations for type certification of a particular product (aircraft, aircraft engine, or propeller).

One commenter indicates that the proposed revision is unjustified and would lead to indiscriminate rule making, and that instead of simplifying the administration of the requirements it would introduce complexity. Another commenter claims that adoption of proposed § 21.16(a) would introduce uncertainty into design requirements.

One commenter suggests that in lieu of revising § 21.16, the FAA should perform a study of § 21.21(b) (2). (Section 21.21(b) (2) provides for denial of a type certificate if an unsafe feature or characteristic exists in the design under consideration. Before adoption of § 21.16, FAA used § 21.21(b) (2) to issue special conditions in letter form.) This commenter suggests that if § 21.21(b) (2) were to continue to be used to issue special conditions to cover an unsafe design feature or characteristic that is not "novel or unusual," it must be equally applicable to a condition that exists on more than one (earlier certificated) product, further stating that the other product or products must then have been type certificated using existing rules which did not adequately cover the unsafe design feature or characteristic. On this premise, the same commenter asks several relevant questions. When § 21.21(b) (2) is applied, does the FAA make it retroactive to the other involved models? Are Airworthiness Directives (Part 39) issued? Why wasn't a special condition issued against the first applicant when the condition was, in fact, novel or unusual? Why was this not followed by a notice of proposed rule making for future application?

These comments and questions caused the FAA to completely reevaluate its practices in designating the applicable regulations for type certification under § 21.17(a), commonly referred to as defining a "type certification basis."

After further consideration of the comments received as well as FAA practice in designating the applicable regulations, and the objectives of proposed § 21.16, the FAA agrees that this proposal should be withdrawn because of the potential for possible abuse of general rulemaking procedures, of the requirements of the Administrative Procedure Act, and the intent of Executive Order 12044. As explained below, the objectives of proposed § 21.16 will be satisfied by the application of a new FAA policy affecting the designation of applicable regulations for the type certification of new aircraft, aircraft engines, and propeller designs. These future practices are consistent with the FAA General Rule-Making Procedures of Part 11, the Administrative Procedure Act, and Executive Order 12044.

Section 21.16 is one paragraph of a number of paragraphs used to define the type certification basis of a new product. Companion paragraphs of importance to this discussion include §§ 21.17 and 21.21. Section 21.17(a) provides that the applicable airworthiness standards are (1) those requirements of this subchapter that are effective on the date of application for a type certificate, unless otherwise specified by the Administrator or unless compliance with later effective amendments is elected by the applicant or required by special retroactive regulations (e.g., § 25.2), and (2) any special conditions prescribed by the Administrator in accordance with § 21.16. Section 21.16 provides for the issuance of special conditions when the Administrator finds that the existing airworthiness standards do not contain adequate or appropriate safety standards *because of novel or unusual design features* of the product to be type certificated. Section 21.21(b) (1) permits noncompliance with specific provisions of the airworthiness standards when there are compensating factors that provide an equivalent level of safety. Such determinations are commonly referred to as "equivalent safety findings." Section 21.21(b) (2) provides for the denial of a type certificate, notwithstanding a showing of compliance with the applicable airworthiness standards designated in accordance with § 21.17, if the Administrator finds an unsafe feature or characteristic of the product for the category in which certification is requested.

Sections 21.16, 21.17, and 21.21, taken together with FAA policy in designating the applicable regulations must recognize and balance four important considerations: (1) the FAA has an obligation under Section 601 of the Federal Aviation Act of 1958 to keep the airworthiness standards of this subchapter (i.e., FARs 23, 25, 27, 29, 31, 33, and 35) as current as practicable; (2) the type certificate applicant has a right and a need to know, in very specific terms, what the applicable airworthiness standards will be in order to finalize the detail design of its product and to enable the applicant to make reasonable performance guarantees to its potential customers; (3) in the interests of safety, rapid technological advances presently being made by the civil aircraft industry require that the FAA be able to issue special conditions to address truly novel or unusual design features that it has, as yet, not had an adequate opportunity to envisage in the airworthiness standards through the general rulemaking process; and (4) because the airworthiness standards of this subchapter are intentionally objective in nature to allow flexibility in design, the FAA must retain the prerogatives both to make equivalent safety findings and to deny a type certificate whenever an unsafe design feature or characteristic is found during the type certification process.

The phrase "novel or unusual" as used in § 21.16 is a very relative term. As used hereafter in applying § 21.16 to justify the issuance of special conditions, "novel or unusual" will be taken with respect to the state of technology envisaged by the applicable airworthiness standards of this subchapter. It must be recognized that in some areas which will vary from time to time the state of the regulations may somewhat lag the state of the art in new design because of the rapidity in which the state of the art is advancing in civil aeronautical design and because of the time required to develop the experience base needed by the FAA to proceed with general rule making. Applicants for type certification of a new design have the opportunity to mitigate the impact of not knowing the precise airworthiness standards to be applied for "novel or unusual design features" by consulting with the FAA early in their certification planning when such features are suspected or known by the applicant to exist. It should also be recognized that, because of the intentional objective nature of the airworthiness standards of this subchapter, many new design features which might be thought of as "novel or unusual design features" may already be adequately covered by existing regulations, thus obviating the need to issue special conditions.

Henceforth, the special condition will not be issued for general upgrading of the applicable airworthiness standards when novel or unusual design features are not involved. Whenever the FAA determines that an upgrading of the airworthiness standards of this subchapter is warranted, the upgrading will be promulgated as an amendment to this subchapter consistent with the general rulemaking procedures of FAR Part 11, the Administrative Procedure Act, and Executive Order 12044. Should the FAA conclude that there is a compelling safety need to apply a proposed amendment retroactively to designs already type certificated or to designs for which a type certificate application is in progress, the retroactive aspects of the proposed amendment, if supportable by a regulatory analysis completed in accordance with Executive Order 12044, will be announced in the notice or proposed rule making for that amendment. Public comments on the proposed retroactive aspects will be considered in determining the applicability of the adopted rule.

A number of products for which special conditions have not as yet been issued are undergoing type certification at the time of this amendment. Should the FAA conclude that recent or future amendments to this subchapter should be applied to these products that would not otherwise be applicable under § 21.17(a) (1) then an amendment to require retroactive application will be proposed and acted upon through the general rulemaking process explained above, in lieu of issuing special conditions under § 21.16.

Also, the provisions of § 21.21(b) (2) will no longer be used to justify the issuance of special conditions. However, just as an Airworthiness Directive may be issued under Part 39 to require the correction of an unsafe condition that is likely to exist or develop in a product of the same type design, notwithstanding a showing of compliance with the applicable airworthiness standards, § 21.21(b) (2) may continue to be used to deny issuance of a type certificate if a similar unsafe feature or characteristic is found during the type certification process, notwithstanding a showing of compliance with requirements designated by § 21.17. The unsafe features and characteristics envisaged by § 21.21(b) (2) are those related to specific design configuration or product characteristics of a particular design, that one would not normally expect the applicable airworthiness standards to specifically preclude because of their intentionally objective nature.

It is the practice of the FAA to develop and publish a Type Certificate Data Sheet as an integral part of each type certificate. The type certification basis is recorded on the Type Certificate Data Sheet for public information. In the future the type certification basis statement will identify not only the applicable regulation, including special conditions, but also will identify all exemptions issued pursuant to Part 11, together with "equivalent safety findings" made in accordance with § 21.21(b) (1).

For the above reasons, Proposal 8-2 is withdrawn.

In considering its disposition of the proposal to amend § 21.16(a), the FAA realizes that a "novel or unusual design feature" today may become a common design feature of the future. The issuance of a like special condition for several product designs will most likely compel general rule making on that subject and the history of that special condition could have a very strong influence on thinking when general rule making is initiated. Also, although special conditions are regulations of particular product applicability, they are issued only in the interest of public safety. For these reasons, Part 11, and § 21.16 of Part 21 are amended to require special conditions to be issued in accordance with the existing general rule-making procedures. As is now the case, a docket will continue to be maintained for each set of special conditions, and all material in the docket will continue to be available for public review.

Proposal 8-3. This proposal is one of a group of proposals dealing with the establishment of Instructions for Continued Airworthiness and the responsibilities of maintenance personnel and aircraft operators with respect to those instructions. The group is made up of the following proposals: 8-3, 8-5, 8-21, 8-25, 8-58, 8-62, 8-64, 8-67, 8-77, 8-80, 8-89, 8-91, 8-92, 8-93, 8-97, 8-98, 8-99, 8-104, 8-106, 8-107, 8-110, and 8-111.

A commenter representing a number of scheduled air carriers objects to the requirement in § 21.31(c) that the type design include the Airworthiness Limitations section of the Instructions for Continued Airworthiness because of the information to be included in that section. Although this commenter does not object to including mandatory replacement times for life-limited parts in the Airworthiness Limitations section, the commenter strongly objects to including inspection intervals and related procedures. Under proposed §§ 43.16 and 91.163(c), the commenter points out, air carriers would be required to comply with these maintenance-related airworthiness limitations. The FAA does not agree that inspection intervals and related procedures can be omitted from the Airworthiness Limitations section of the Instructions for Continued Airworthiness. For example, the proposed Airworthiness Limitations section on a transport category airplane must contain mandatory inspection intervals and related procedures because the damage-tolerance concept described in § 25.571 is predicated upon the use of such inspections to detect initial cracks in principal structural elements before crack growth under repeated loads could progress to a degree which would cause catastrophic failure of the airplane. However, the FAA does agree that §§ 43.16 and 91.163(c) should permit modification of these intervals and procedures by other FAA approved methods. Accordingly, inspection programs approved under §§ 121.25(b), 121.45, 121.367, 123.21(b), 127.13(b), 127.133, 135.5, 135.17, 135.419, 135.421, and 135.425, as defined by approved operations specifications, or an inspection program approved under § 91.217(e) constitute acceptable alternatives. The appendices to Parts 23, 25, 29, 31, 33, and 35 as adopted in this amendment require the applicant to specify (in the Airworthiness Limitations section) mandatory replacement times, inspection intervals, and related procedures. Sections 43.16 and 91.163(c) have been revised to show that only the inspection times and procedures may be adjusted under approved alternative programs.

A commenter objects to § 21.31(c), which in general is applicable to manufacturers, since continued airworthiness, which is covered in the paragraph, is the responsibility of the operator. Because this comment pertains more directly to § 21.50, it is dealt with in conjunction with Proposal 8-5.

In addition to comments relating to the Instructions for Continued Airworthiness, a commenter objects to § 21.31(a) because the proposal to include a list of drawings and specifications in the type design was not mentioned at the Airworthiness Review Conference. In fact, this proposal did appear as an FAA comment on Proposal No. 565 in the Committee I Workbook (titled "Procedures and Special Subjects") made available to all participants at the conference, and may be found in the docket.

Several commenters object to § 21.31(d) because including analyses in the type design—(1) would be redundant, since it is already required as part of the substantiating data; (2) is unnecessary, since the drawings and specifications required under current § 21.31(a) provide the general information needed by the FAA; and (3) introduces the possibility that the FAA would require the manufacturer to provide any and all data used to prepare the drawings and specifications, thereby delaying type certification. The FAA agrees that proposed § 21.31(d) would serve no useful purpose and it is withdrawn.

Proposal 8-4. A commenter objects that § 21.35(b) (2) eliminates flight testing for reliability, contending that analysis and ground test are not dependable as a basis for certification. In the light of this comment, and after further consideration and experience, the FAA has determined that flight testing for reliability does provide safety information not necessarily obtainable from analysis and ground test. Accordingly, the proposal to delete the reference to reliability in § 21.35(b) (2) is withdrawn.

No adverse comment was received on the proposal to replace the word "airplanes" in § 21.35(b) (2) with the word "aircraft" and this amendment to § 21.35(b) (2) is adopted without change.

Proposal 8-5. A commenter objects to the continued airworthiness provisions of § 21.50(b) (and also proposed § 21.31(c)) contending that—(1) continued airworthiness is the responsibility of the operator/owner; (2) current regulations in Parts 23 and 25 already require manufacturers to make available recommended maintenance procedures for the product at the time of its delivery; (3) current operating rules require the operator/owner to establish and comply with a maintenance program; and (4) with respect to transport airplanes, the present FAA Maintenance Review Board (MRB) system is an entirely satisfactory way of establishing the means for maintaining airworthiness. Current FAA practice allows operators of new transport category airplanes to utilize FAA MRB recommendations (reference FAA Advisory Circular No. AC 121-22) for starting their maintenance programs, and then vary them with FAA approval as experience and operating conditions dictate. The commenter points out that, contrary to that practice, the amendment will require the manufacturer to obtain FAA approval of its recommended maintenance procedures before the airplane is type certificated, and to obtain FAA approval of revisions to those procedures (necessitated by any improvement change in the airplane) before approval of the change itself. This, the commenter states, will impose a severe and unnecessary hardship on the manufacturer.

On the first and second points, although the operator/owner does have responsibility for continued airworthiness, the FAA has found that the recommended maintenance procedures made available under current regulations are frequently inadequate in scope and content, and often do not provide a sound basis for the operator/owner to maintain the airworthiness of the aircraft. The FAA has concluded that the lack of such recommended maintenance procedures can best be remedied by requiring that they be made available to owners and operators by the type certificate or supplemental type certificate holder. On the third point, while it is true that not all operators/owners are required to establish and comply with a continuous airworthiness program, those that voluntarily wish to set up such a program are often handicapped by the lack of comprehensive instructions, which would be remedied by § 21.50(b). On the other hand, those required to establish a program will benefit from the more detailed and comprehensive instructions made available to them under § 21.50(b). On the fourth point, which is directed toward aircraft that will be maintained in accordance with an FAA approved operations specification and maintenance program under Parts 121, 123, 127, 135, or an approved inspection program under § 91.217(e), the FAA recognizes that these procedures for maintaining airworthiness of the products have functioned satisfactorily. In this regard, the FAA expects that operating segments of the air transportation industry would continue to work with type certification applicants in defining adequate maintenance instructions prior to type certification. The FAA MRB document, which is a product of contributions made by both the operators and manufacturer, could be picked up by the type design holder and included as a part of the required Instructions for Continued Airworthiness, thus continuing the usefulness of the existing MRB practices for the original entry into service of new product designs. Likewise, the additional maintenance instructions that would be required and which are not typical to MRB documents, but are presently required in air carrier operators' FAA approved maintenance programs, could also be picked up by the type design holder. Therefore, the screening process that would be utilized by the FAA in reviewing such maintenance documents would not unnecessarily delay type certification or approval of design changes after certification. See also the discussion under Proposal 8-3.

A commenter questions the need for the provision in § 21.50(b) requiring that the Airworthiness Limitations section of the Instructions for Continued Airworthiness be furnished with each aircraft, engine, or propeller. The FAA agrees that this provision is unnecessary, as the type certificate holder must make the manual available, and the operator/owner must comply. To require a manual to be furnished with each equipment would be redundant, and in some instances, would be unnecessary. Accordingly, the requirement that the Airworthiness Limitations section be furnished with each airplane or product is revised to require that the section be furnished to each owner of the type.

A commenter objects to § 21.50(b) insofar as it applies to rotorcraft type certificated under Parts 27 and 29, contending that the manufacturer is already required under those parts to furnish a maintenance manual, which has allegedly been proven adequate. The FAA does not agree. The proposed Instructions for Continued Airworthiness, which are broader in scope and more detailed than the maintenance manual currently required under Parts 27 and 29, would provide the operator/owner with the minimum amount of information needed to maintain the airworthiness of increasingly complex rotorcraft currently being designed.

A commenter suggests that § 21.50(b) be revised to make it clear that an aircraft manufacturer need not supply Instructions for Continued Airworthiness pertaining to engines and propellers until the complete aircraft is delivered to the first retail purchaser. The continued airworthiness instructions for propellers and engines should be provided to the aircraft manufacturer to facilitate transmittal to purchasers of the aircraft.

A commenter notes that § 21.50(b) would require an aircraft manufacturer to make the Instructions for Continued Airworthiness available to the owner upon delivery of the aircraft and to any other person required to comply with any of the terms of those instructions *upon request*. Since such a request could be made before the first aircraft delivery, it could impose an unnecessary burden on the aircraft manufacturer. The commenter suggests that § 21.50(b) be revised so that such a request need not be filled until after delivery of an aircraft to the first owner. The FAA agrees that an early request for the Instructions for Continued Airworthiness could impose an unnecessary burden on the manufacturer. Additionally, the FAA notes that airplanes can be delivered to an operator, prior to full type certification, with a provisional airworthiness certificate to allow activities such as crew training, and therefore prior to the approval of the Airworthiness Limitations section. Accordingly, the phrase "upon request" has been deleted from § 21.50(b) and the language has been revised to require that at least one set of the complete Instructions for Continued Airworthiness be furnished upon delivery to the customer, or subsequent to issuance of the first standard certificate of airworthiness, whichever occurs later.

Proposal 8-6. Commenters object to the proposal to make § 21.97(b) applicable to all products rather than to engines only because—(1) the volume of paperwork would increase out of proportion to any benefits that might be gained; (2) the applications for supplemental type certificates would be significantly more complex, since there are frequently many configuration variations within an aircraft model and a fleet operator would have to list all of the configurations or make separate application for each; and (3) the term "specific configuration" must be defined if the proposal is to be properly administered. In light of these comments and after further consideration, the FAA concludes that this proposal requires additional study and it is withdrawn.

Proposal 8-7. No unfavorable comment was received on the proposal to amend § 21.123 to require a manufacturer to submit a manual describing its production inspection system and means for controlling materials and parts. Accordingly, the proposal is adopted without substantive change.

Proposal 8-8. A commenter objects to § 21.143(a)(2) contending that substitution of the word "supplier" for "subsidiary" introduces a major change to the requirements, involving increased paperwork and costs. The FAA does not agree. The FAA has consistently administered § 21.143(a)(2) as applying to *all* raw materials, purchased items, parts, and assemblies supplied to the prime manufacturer. The change does not involve increased paperwork or costs because it is a semantic change which clarifies the definition of persons or entities subject to the quality control data requirements of § 21.143, without expanding any of those requirements. The use of the term "subsidiary" is unclear because it implies that there must be a corporate connection between the prime manufacturer and his supplier. Accordingly, the language has been revised to reflect the FAA's intent that the quality control data requirements of § 21.143(a)(2) apply to all "suppliers" of each prime manufacturer. For similar reasons and for internal consistency, § 21.143(b) is revised to replace the term "subsidiary manufacturers" with the term "suppliers".

Proposal 8-9. No unfavorable comment was received on the proposal to amend § 21.182 to ensure that the proposed new § 45.11(c) is cross referenced. Accordingly, the proposal is adopted without substantive change.

Proposal 8-10. A commenter raises the question whether a special flight permit issued under § 21.197(a) (3) would serve as a certificate of airworthiness for international flights. The FAA notes that international flights cannot be conducted under special flight permits issued under § 21.197 unless specifically authorized by the foreign authorities concerned.

Another commenter objects to § 21.197(a) (3) (ii) because as worded, the individual aircraft would have to be flown for at least 50 hours, thereby defeating the purpose of the original proposal (as submitted for the Airworthiness Review) which aimed at eliminating unnecessary delays in obtaining FAA approval of customer demonstration flights. The commenter suggests that this provision be changed to stipulate that the aircraft type must have been flown for at least 50 hours. The FAA agrees that since the proposal concerns aircraft manufactured under a production certificate, and since the aircraft type could have been flown for at least 50 hours during the type certification program, the 50 hours of flight provision is not necessary. However, the FAA does not agree with the commenter's suggested revision. It is necessary to require that production flight tests for the individual aircraft involved be satisfactorily completed before that aircraft is flown on customer demonstration flights. Accordingly, § 21.197(a) (5) is added to prescribe this condition in place of the 50 hours of flight provision.

The same commenter also suggests that § 21.197(a) (3) (ii) should be made applicable to aircraft produced under a type certificate only, since such aircraft received close production surveillance by the FAA. The FAA agrees that a production certificate should not be the limiting factor in obtaining FAA approval of customer demonstration flights. If the aircraft has been demonstrated to otherwise meet all the safety requirements for a standard airworthiness certificate, then customer demonstration flights could be permitted. This proposal is adopted by the addition of § 21.197(a) (5).

In addition, the commenter suggests that proposed § 21.197(a) (3) (ii) be amended with a reference to the maintenance and inspection programs called for under § 21.195 for Experimental and Subpart C Provisional Type Certificates. Such procedures would unnecessarily complicate the issuance of permits for customer demonstration flights and would in effect nullify the original proposal. The portion of the proposal calling for maintenance and inspection programs in these instances is therefore withdrawn.

Proposal 8-11. No unfavorable comments were received on the proposal to amend § 23.253(b) (3) to ensure that high speed buffeting does not become severe enough to prevent the pilot from reading the instruments or controlling the airplane. Accordingly, the proposal is adopted without substantive change. Also see Proposal 8-28.

Proposal 8-12. No unfavorable comments were received on the proposal to amend § 23.361 to redefine the limit engine torque load conditions to be considered for turbine engine installations and to make other clarifying changes. Accordingly, the proposal is adopted without substantive change.

Proposal 8-13. The FAA does not agree with a commenter who suggests that the lead-in of § 23.371 be revised to make the gyroscopic load requirements applicable to piston as well as turbine engines. The FAA has no information to indicate a need for coverage of piston engines in this regulation, nor was any submitted by the commenter.

Another commenter concurs with § 23.371, assuming that a rational analysis of loads under § 23.371(a) is an alternate to the loads specified in § 23.371(b). This assumption is correct. No change to § 23.371 was proposed in this regard. Section 23.371 is adopted without substantive change.

Proposal 8-14. A commenter suggests that the word "operated" in § 23.729(c) be replaced by the word "lowered". The commenter states that the intent of the rule is to ensure that the gear can be lowered in an emergency. The FAA concurs, but the word "extended" is used to preserve the internal consistency of the section. Section 23.729(c) is revised accordingly.

This commenter also questions whether § 23.729(e) would require an "up lock". The commenter is evidently referring to a "lock" in the sense of a positive means other than hydraulic pressure, as required to keep the gear extended by § 23.729(b). Section 23.729(e) contains no such requirement.

Another commenter suggests that the second sentence of § 23.729(e) be revised to add the words "and secured" after the words "fully extended" and "fully retracted" in order to clarify what functions the lights would indicate to the pilot. The first sentence of the paragraph clearly states that the indicators should inform the pilot that the gear is secured in the extended or retracted position.

A commenter states that the proposal is redundant since the requirement is already in effect. The FAA does not agree. This is one of several new provisions being incorporated into the current regulations to assure the reliability of small land-plane landing gear systems.

After further review, the FAA has determined that the words "and warning device" should be removed from the heading of § 23.729(e) to preclude confusion between the requirements of this paragraph and those of § 23.729(f). Section 23.729 is adopted with editorial changes and the revisions discussed.

Proposal 8-15. A commenter objects to § 23.903(f) on the grounds that it imposes new and unjustified criteria for restart capability of reciprocating engine powered airplanes. The FAA believes the requirement to be fully justified. Accidents have occurred with multiengine reciprocating powered, as well as turbine powered airplanes because pilots have not been adequately apprised of the engine restart envelope for their airplane. Therefore, the requirement must apply to both types of engine installations.

This commenter further states that § 23.903(g) is acceptable provided that the "restart requirement is understood to be within the restart envelope for the aircraft (if one is approved for the aircraft)." Present § 23.903(e) (3), as applicable to turbine engine powered small airplanes, states that it must be possible to restart an engine in flight, and § 23.903(f) requires that an approved restart envelope be established. Therefore, development of a restart envelope would be required for the approval of each turbine engine powered small airplane. As adopted, § 23.903(g) requires that, following in-flight shutdown of all engines, electrical power for ignition exists throughout the approved restart envelope.

Another commenter states that it seems inconsistent to require that electrical power be provided for ignition but not for rotational capability sufficient for an engine start. The FAA does not agree. As adopted, the rule provides for those circumstances where engine windmilling speed is sufficient for restarting but insufficient to provide electrical power for ignition.

The proposal is adopted without substantive change. However, § 23.903(f) is revised to make it clear that the specified in-flight engine restart capability is required throughout the required altitude and airspeed envelope.

Proposal 8-16. No unfavorable comment was received on adding a new § 23.905(d) referencing propeller blade pitch control system durability requirements. Accordingly, § 23.905(d) is adopted without substantive change. For discussion of a related proposal to add a new § 35.42, see the discussion under Proposal 8-103.

Proposal 8-17. A commenter suggests that since the requirement for fuel tanks to retain fuel during a landing with landing gear retracted or collapsed may be subject to individual interpretation, advisory material on compliance methods should be reviewed with industry prior to implementation of the rule. The FAA does not agree. The revision merely clarifies an existing requirement. Section 23.967 is adopted without substantive change.

Proposal 8-18. A commenter recommends that the proposal to add a new § 23.991(d) which requires that operation of any fuel pump does not adversely affect continuous engine operation, be withdrawn or its adoption delayed while the compatibility of engine and airplane fuel systems is studied. The compatibility between these systems must be established in the design process, and the relevant design considerations are well known. Delaying the requirement in favor of additional study is not warranted.

Another commenter contends that the requirement is beyond the needs of safety. The FAA agrees that the proposed requirement is too restrictive and § 23.991(d) is revised to provide that the operation of any fuel pump may not affect engine operation so as to create a hazard.

Two commenters disagree with adding a new § 23.991(d), contending that it eliminates present fuel system designs. The FAA has no information to suggest that compliance with the revised section, as discussed above, would be impossible using present fuel system designs, nor was any presented by the commenter.

The proposal is adopted with the revision discussed above.

Proposal 8-19. No unfavorable comments were received on the proposal to amend § 23.1305(n) to permit movement of the propeller blade up to 8° below the flight low pitch position before an indication of the movement is required for the flight crew. Accordingly, the proposal is adopted without substantive change.

Proposal 8-20. For comments related to withdrawal of the proposal to revise § 23.1521(a), see Proposal 8-94.

Proposal 8-21. Since the proposal for § 23.1529 is substantively identical to those for §§ 25.1529 (Proposal 8-58), 27.1529 (Proposal 8-64), and 29.1529 (Proposal 8-77), all comments on these proposals are considered here.

A commenter notes that although the explanation for § 23.1529 makes it clear that the Instructions for Continued Airworthiness need not be finalized until delivery of the first airplane, the proposal itself seems to require that they be finalized before type certification. The commenter suggests that this point be clarified. The FAA agrees, and §§ 23.1529, 25.1529, 27.1529, 29.1529, 31.82, 33.4, and 35.4, are revised accordingly.

In response to a commenter representing a group of scheduled air carriers, the FAA notes that, except for the Airworthiness Limitations section, there is no requirement that any operator/owner use the Instructions for Continued Airworthiness referred to in §§ 23.1529, 25.1529, 27.1529 and 29.1529. Moreover, the new §§ 43.13(a), 43.16, and 91.163(c) allow the use of other methods. In particular, the use of maintenance manuals and continuous airworthiness maintenance programs developed under current Parts 121, 123, 127, and 135, or an inspection program approved under current § 91.217(e), would be acceptable alternatives to the Airworthiness Limitations section. This commenter suggests that language be added to § 25.1529 to make it clear that alternatives to the Instructions for Continued Airworthiness (except the Airworthiness Limitations section) may be used. This suggestion was not adopted because §§ 43.16 and 91.163(c) make this provision sufficiently clear.

Proposal 8-22, 8-23, and 8-24. Final action on Proposals 8-22, 8-23, and 8-24 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-25. The proposals to add an appendix to Parts 23, 25, 27, and 29 (Proposals 8-62, 8-67, and 8-80) setting forth Instructions for Continued Airworthiness are substantively identical and are discussed below. Unless otherwise stated, the discussion refers to the designated sections in each of the appendices mentioned above.

§ *XX.1(a).* A commenter objects to the concept of specifying requirements (as opposed to providing guidance) for the preparation of Instructions for Continued Airworthiness, contending that such requirements would lead to time-consuming negotiations between the manufacturer and the FAA, and that some flexibility in providing the instructions is necessary. The appendix sets forth, in broad objective terms, the *kinds* of information the Instructions for Continued Airworthiness must contain. Within this framework, the manufacturer would be free to develop detailed instructions appropriate to its aircraft. The FAA is confident that the appendix provides a reasonable measure of flexibility, and anticipates no difficulties or delays in determining the acceptability of the Instructions developed by the manufacturer.

§ *XX.1(b).* A commenter objects to the requirement that Instructions for Continued Airworthiness be provided for appliances, contending that—(1) this information is often not available from the appliance manufacturer; (2) even when available, the information sometimes has to be revised for the particular application in a manner not approved or intended by the appliance manufacturer; and (3) the information necessary for customized equipment installations would be unreasonably costly to develop. The FAA does not agree. Such information, which is essential to the continued airworthiness of the aircraft, should be provided for each required product. Accordingly, the language of § XX.1(b) is revised to make it clear that if the aircraft manufacturer does not supply continued airworthiness instructions for the product, the Instructions for Continued Airworthiness for the aircraft must include this information. See also the discussion under § XX.3(a) (5) (i).

A commenter objects to the proposal to include information on engines and all appliances in the Instructions for Continued Airworthiness, contending that—(1) such information should be furnished by the engine or appliance manufacturer; and (2) with respect to appliances, only those for which standards have been established by FAA should be covered. On the first point, manufacturers of new engine designs are required to supply the information for their products under new § 33.4. Manufacturers of new aircraft using currently certificated engines are required by § XX.1(b) to provide the information for the engine in their Instructions for Continued Airworthiness for the aircraft. In practice, the FAA expects this information to be developed and supplied by the engine manufacturer. A similar requirement for appliances would be administratively impracticable because of the large number involved. On the second point, it should be noted that specific performance and safety standards have not been established for all essential appliances. However, upon further review, the FAA concludes that it would be unreasonable to require the aircraft manufacturer to cover appliances other than those required in applicable regulations. Accordingly, § XX.1(b), as adopted, refers only to appliances "required by this chapter."

§ *XX.2.* A commenter suggests a revision of this section to make clear that the Instructions for Continued Airworthiness may consist of a series of volumes, or may be supplied in other than book form, such as on microfilm or microfiche. The language in § XX.2 is sufficiently broad to cover these acceptable alternatives. Reference to the Air Transportation Association of America Specification No. 100 (where it appeared) is deleted from § XX.2(b) because it is nonregulatory.

§ *XX.3, lead-in paragraph.* A commenter objects to the requirement that the contents of the manual "be prepared to be understood by the persons who will be responsible for maintaining" the aircraft or product, contending that—(1) it would impose a subjective standard that would be impossible to meet; and (2) it could be interpreted to mean that, in some circumstances, manuals for aircraft to be exported must be prepared in the language of the country of export. In light of these comments, the first sentence of the lead-in paragraph of § XX.3, is revised to read as follows: "The contents of the manual or manuals must be prepared in the English language." This conveys the intent of the original proposal. A commenter points out that there may be different levels of maintenance instructions, directed at different classes of operators. For example, the maintenance instructions provided to a fleet operator or commuter airline may be more comprehensive than those provided to a fixed base operator. Any level of maintenance instructions considered appropriate by the manufacturer may be submitted, provided that those instructions comply with the minimum standards in the appendix.

§ *XX.3(a) (2).* A commenter recommends that the requirement for complete descriptions be limited in scope to the "standard" aircraft and "quantity-installed" optional equipment, contending that it would be virtually impossible to devise "custom" maintenance manuals for each product because of the many combinations of equipment that may be ordered by the purchaser. In addition, the commenter states that a manual containing all of these combinations would be difficult to use. The FAA does not agree. To achieve its purpose, the Instructions for Continued Airworthiness must contain information on each item of equipment required by regulation to be installed on the aircraft. The FAA notes that supplemental type certificates (STC's) are required for installation of equipment not a part of the type certificate, and that this maintenance manual requirement is equally applicable to the STC applicant.

§ *XX.3(a) (3)*. A commenter recommends that since maintenance personnel have no need for the kind of operating information provided in a Pilot's Operating Handbook, the paragraph be revised to require only *basic* principles of equipment control and operation. The FAA agrees, and § XX.3(a) (3) now refers to "basic control and operation information."

§ *XX.3(a) (5) (i)*. A commenter recommends that applicants be allowed to refer to a component manufacturer as a source of information instead of including the information in the Instructions for Continued Airworthiness. The commenter argues that many component manufacturers prefer to maintain control of their maintenance information to ensure that it is up to date. In other cases, maintenance at the factory may be required because of the complexity of the equipment. The FAA recognizes that some accessories, instruments, and equipment have an exceptionally high degree of complexity, requiring specialized maintenance techniques, test equipment, or expertise. In such cases, it would be in the interest of safety to allow the applicant to refer to the appropriate manufacturer in the maintenance instructions. The FAA does not agree, however, that such reference should be allowed in other circumstances. Section XX.3(a) (5) (i) (redesignated § XX.3(b) (1)) is revised accordingly.

A commenter recommends that the last sentence of § XX.3(a) (5) (i), be revised to allow reference to a separate inspection program, rather than include it in the maintenance instructions, so that the inspection program could be better kept current and also tailored to an individual operator's needs. The FAA does not agree. The inspection program must be set forth in the Instructions for Continued Airworthiness to ensure its availability to those who will benefit from it.

The FAA, after further study of § XX.3(a) (5) (i), has decided that the provision should specifically require a description of applicable maintenance or wear tolerances. Section XX.3(a) (5) (i) (redesignated § XX.3(b) (1)) is clarified in this regard.

§ *XX.3(a) (5) (ii)*. A commenter objects to the words "could occur" in this paragraph because it encompasses everything within the realm of possibility, thereby unnecessarily increasing the volume of the maintenance instructions. The phrase "probable malfunctions" replaces the phrase "typical malfunctions that could occur" in § XX.3(a) (5) (ii) (redesignated § XX.3(b) (2)).

§ *XX.3(a) (5) (iii)*. A commenter suggests that this paragraph would be clearer if the first three words and the last five words are deleted. Section XX.3(a) (5) (iii) (redesignated § XX.3(b) (3)) is revised accordingly.

§ *XX.3(a) (5) (iv)*. A commenter suggests revision of this paragraph to make it clear that the overweight landing check refers to the condition in which a certificated landing weight is lower than certificated takeoff weight, since the aircraft manufacturer cannot speculate what damage might be done to an aircraft that takes off and must immediately land at a weight near the certificated takeoff weight. This comment may have merit for certain aircraft. Moreover, since an overweight landing is but one of several occurrences which would necessitate a check to determine aircraft damage, to single out one occurrence would imply that the others need not be covered in the maintenance instructions. Accordingly, the words "checks after an overweight landing" are deleted from § XX.3(a) (5) (iv) (redesignated § XX.3(b) (4)).

§ *XX.3(b)*. A commenter recommends deletion of the requirement for an overhaul manual or section, contending that—(1) there are many products that, for safety reasons, should not to be overhauled; and (2) the manufacturer must make the technical assessment as to whether a product can be safely overhauled. In the light of these comments, and after further consideration, the FAA finds that those portions of § XX.3(b) that provide for overhaul information only (except for engines), should not be required in the Instructions for Continued Airworthiness. Accordingly, §§ XX.3(b) (1) (i), XX.3(b) (1) (ii), XX.3(b) (1) (iv), XX.3(b) (1) (viii), and XX.3(b) (3), are withdrawn. The other provisions of § XX.3(b) specify information that is needed for purposes other than overhaul.

§ *XX.3(b) (1) (iii)*. No adverse comment was received on this proposal to require structural access plate information. Accordingly, it is adopted as proposed, but redesignated § XX.3(c).

§ *XX.3(b) (1) (v)*. No adverse comment was received on this proposal to require instructions on special inspection techniques. Accordingly, it is adopted as proposed, but redesignated § XX.3(d).

§ *XX.3(b) (1) (vi)*. A commenter points out that no part can be restored to its original condition by protective coatings or treatments. The FAA agrees, and § XX.3(b) (1) (vi) (redesignated § XX.3(e)) is revised to make this clear and to require only the information necessary to apply protective treatments to the structure after inspection.

§ *XX.3(b) (1) (vii)*. No adverse comment was received on this proposal to require data on structural fasteners. Accordingly, it is adopted as proposed, but redesignated § XX.3(f).

§ *XX.3(b) (1) (ix)*. No adverse comment was received on the proposal to require a list of special tools. Accordingly, it is adopted as proposed, but redesignated § XX.3(g).

§ *XX.3(c)*. Three commenters object to the concept of supplying generalized repair data. One contended that—(1) the nature of the damage may not be known in a particular case, though it may appear to fall under a general repair "fix"; (2) the safety of the product may be seriously impaired by repairs made in such instances; and (3) the manufacturer can provide alternate means for a mechanic to obtain repair data. In the light of these comments, the FAA agrees that it is not necessary to include the repair information in the Instructions for Continued Airworthiness as proposed. Accordingly, proposed § XX.3(c) is withdrawn.

§ *XX.4*. A commenter suggests that the manufacturer should be allowed to list items in the Airworthiness Limitations section that it deems necessary to maintain structural integrity, where such items are not called out in the applicable airworthiness standards. Another commenter, representing the scheduled airlines, objects to the inclusion, in the Airworthiness Limitations section, of mandatory replacement times for parts other than life-limited parts and of mandatory inspection intervals. The resolution of these comments is discussed under Proposal 8-3. The language proposed for the Airworthiness Limitations sections of the appendices to Parts 23, 25, 27, and 29 is being retained, except that the mandatory replacement times, mandatory inspection intervals, and related procedures are specified as those associated with structural integrity—including those approved under current § XX.571. It also is made clear that FAA approved alternative programs may be used. To avoid unnecessary restriction being placed on operation, only these items are listed in the pertinent Airworthiness Limitations section. Other items can of course be listed in other sections of the Instructions for Continued Airworthiness.

Proposal 8-26. The addition of new §§ 25.101(i) and (j) would set forth requirements for automatic systems that affect performance, including automatic takeoff thrust control systems (ATTCS). In view of the evolving technology of automatic systems, the special features and functions of each design, and the complex interrelationships with other systems, the FAA has concluded that specific regulations are premature and that safety considerations can be more advantageously addressed in special conditions for specific systems. Accordingly, Proposal 8-26 and related Proposals 8-34, 8-48, and the § 25.1305(c) (9) portion of 8-50 are withdrawn.

Proposal 8-27. The revision of § 25.111(c) (4) will permit changes in power or thrust by an automatic takeoff thrust system but prohibit any change requiring action by the pilot when determining the takeoff path. Although specific proposals relating to criteria for automatic takeoff thrust systems have been withdrawn, the FAA believes that this proposal should be retained as it standardizes the procedure for determining the takeoff path, and is consistent with current practice.

One commenter implies that this rule change will add the task of monitoring conditions and instruments and thereby increase the pilot workload. Other commenters suggest that a limited provision for manual throttle setting be included, or are opposed to the proposal completely on the grounds that safety will be compromised in service. Since the rule will apply in the context of a determination of performance rather than an operating requirement, the proposal is adopted without change.

Proposal 8-28. A commenter suggests that the term "impair" in § 25.253(a) (2) (iii) be changed to "significantly impair". The FAA does not agree. In present high altitude, high Mach number jet airplanes, any recovery from upset or speed anomaly must be done essentially by reference to flight instruments. Therefore, any buffet or vibration condition which would in any way impair the pilot's ability to accurately interpret instrument information cannot be tolerated. The same commenter stated that some interpretative material on vibrational frequencies and levels of acceleration would be useful. Use of interpretative material would divert attention from the primary consideration, impairment of pilot ability, which is qualitative. Proposed § 25.253(a) (2) (iii) is adopted without substantive change.

Proposal 7-17. Although no unfavorable comment was received on the proposal to amend § 25.305(d), two commenters state that their agreement was with the understanding that both the discrete gust and the continuous turbulence analyses are required. Present § 25.341(a) requires that limit load factors be established by reference to a discrete gust encounter. Present § 25.305(d) specifies that the dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. Both analyses are required.

Two commenters recommend that present § 25.341 be amended to require dynamic loads analysis by reference to discrete gusts having varying gust gradient distances. The FAA does not agree. The combination of discrete gust analysis under § 25.341 and continuous turbulence analysis under § 25.305 is less complex than the method described by these commenters and provides sufficient substantiation of strength. The proposal is adopted without substantive changes.

Proposal 8-29. Many negative comments were received on the proposal to revise § 25.307(a) to require ultimate load tests for each normal and fail-safe critical load condition. Three commenters indicate that the proposed regulation would add to the cost and time required for certification although present airplane safety records do not support the need for a change. One commenter points out that the design philosophy used for commercial transports, due to the dominant influence of the economic requirement for long life without structural fatigue problems, often produces reserve margins of safety. Another commenter proposes that ultimate load tests be limited to structures such as composites, which substantially differ from conventional structure. The FAA agrees that to conduct ultimate load tests for all critical load conditions would greatly increase the amount of testing required, which is not warranted by the safety record since there have been no service features which indicate that present methods of substantiation are inadequate. In many cases failures in service result from conditions such as fatigue or corrosion which are not covered by ultimate load tests. The proposal to require ultimate testing of all structural components therefore is deleted. In some cases, however, analysis must be supplemented by limit and/or ultimate load tests. The amendment, as adopted, is revised accordingly.

Proposal 8-30. Several negative comments were received on §§ 25.365(e) and (f), requiring airplane designers to consider pressure vessel decompression resulting from the loss of any nonplug door, detonation of a bomb within the cabin at all probable locations, and engine disintegration. Several commenters oppose designing for the loss of a nonplug door, stating that there is no reason why nonplug doors cannot be designed to be as safe as plug doors. These commenters suggest that the door design criteria be upgraded to improve door integrity. The FAA agrees that door integrity should be improved to the extent that design for their loss is not justified. Therefore § 25.783 is revised in response to Proposal 8-35 to require this improved level and § 25.365(e) (1) is withdrawn.

Many commenters object to designing for all possible bomb detonations and probable bomb locations. A commenter points out that airworthiness requirements in the past have attempted to safeguard aircraft against structural and mechanical failure, human error, natural hazards, etc. They note that no one has attempted to incorporate into airworthiness requirements the consequences of homicidal or suicidal tendencies. Another commenter states that the aircraft industry has to accept responsibility for compensating the public for loss or injuries resulting from defects in its products, and the inclusion of a bomb damage requirement in Part 25 could significantly extend the grounds of possible product liability actions, particularly with the imprecise requirements of § 25.365(e). Many commenters state that the wording of § 25.365(e)(3) is so vague as to make its implementation impossible. The FAA notes that, ultimately, minimizing the loss of airplanes as a result of bomb explosions is a ground security problem.

A commenter suggests an alternative to § 25.365(e)(3) which would establish a relationship between the design maximum opening and the cross-sectional area of the pressurized shell. The FAA agrees that the proposed relationship provides an acceptable method for determining hole size. The FAA has determined that the maximum hole size required should be 20 square feet, a value contained in Airworthiness Directive 75-15-05 (August 11, 1975) pertaining to openings in wide-body transports. Section 25.365(e)(3) is revised to allow the maximum opening to vary as a function of the cross-sectional area of the pressurized shell to account for the differences in size between narrow and wide-body transports and is redesignated and adopted as § 25.365(e)(2).

The FAA finds that the maximum opening specified in adopted § 25.365(e)(2) will exceed the opening that would result from causes other than bomb explosions or engine disintegration, and that a probability safety analysis to determine hole size in passenger or cargo areas resulting from other causes is not needed. Thus, proposed § 25.365(f) is withdrawn.

In light of the comments received on proposed § 25.365(e)(4), and after further consideration, the FAA concludes that openings caused by airplane or equipment failure can occur in any compartment, and that partitions, bulkheads, and floors should be designed for openings from these causes. Thus, proposed § 25.365(e)(4) is revised accordingly, redesignated, and adopted as § 25.365(e)(3).

No adverse comments were received on proposed § 25.365(e)(2) to require design to withstand penetration of the cabin by a portion of an engine following engine disintegration and the proposal is redesignated § 25.365(e)(1) and adopted without substantive change.

Amendment to § 25.571(a)(3). Because of the change to § 25.1529 adopted in this amendment, the reference to the "maintenance manual" in § 25.571(a)(3) is no longer appropriate. For consistency, § 25.571(a)(3) references the Airworthiness Limitations section of the Instructions for Continued Airworthiness.

Proposal 8-31. Numerous unfavorable comments were received on the proposal to add a new § 25.633 requiring that essential systems be designed to minimize damage caused by detonation of a bomb in the airplane. Most commenters contend that there is no means to protect essential systems from all possible bomb detonations and that bomb size and location cannot be rationally defined. Several commenters indicate that the separation of essential systems on modern airplanes presently provides a measure of protection and that the proposed requirements of § 25.633 are beyond the state of the art.

The FAA agrees that a rational means of determining and defining all possible bomb size/location combinations which would damage essential systems does not exist. Therefore, the proposal is withdrawn.

Proposal 8-32. Several commenters object to the proposed horizontal stabilizer "trim-in-motion" aural warning requirement of § 25.677(e) on the grounds that the aural environment in today's cockpits is already cluttered and that finding new and distinctive aural warnings is becoming difficult. They further suggest that small increments of trim change should not cause aural warning, and that warnings should be given only when a safety-of-flight hazard exists. One commenter suggests that there is no need for separate aural warning on aircraft having direct trim control wheels in the cockpit.

The FAA agrees with the comments and upon further review concludes that the proposal is premature and unworkable. Accordingly, it is withdrawn for further study.

Proposal 8-33. Several adverse and supporting comments were received on the proposal to add a new § 25.685(e) requiring arrangement of control systems to provide an airplane with the capability of continued safe flight and landing in the event of an inflight localized structural failure. Several commenters agree with the intent of the proposal and propose minor changes. One commenter agrees with the intent of the proposal, but believes that only failures which have not been shown to be extremely improbable need be considered. Commenters state that the intent of the proposed rule change is already encompassed by § 25.365(e) which would require that floor failure resulting from rapid decompression be shown to be extremely improbable.

A commenter further states that present § 25.671(c) requires control systems to be designed to be tolerant of failures, and that control system damage is more likely from other sources. The commenter claims that service experience and rational analysis show that the floor structure provides the best available protection for the control system from damage from these other sources.

After further study the FAA agrees with the commenters that the primary objectives of this proposal are adequately covered by several existing sections of FAR 25. For example: § 25.365(e) requires that the floor be designed for pressure vessel opening which is a function of the cross-sectional area of the fuselage; § 25.571 requires all structure to be damage tolerant where practical; § 25.671 requires that control systems be tolerant of failures, including exterior damage; § 25.629 requires freedom from flutter under failure conditions; § 25.631 requires protection of controls in the empennage structure from bird strikes; and § 25.901(d) requires design precautions be taken to minimize the hazards to the airplane, including control systems, in the event of an engine rotor failure. The proposal therefore is withdrawn.

Proposal 8-34. For an explanation of the withdrawal of the proposals concerning automatic systems that affect airplane performance, one of which is the proposal to add a new § 25.705, see Proposal 8-26.

Proposal 8-35 and 2-59. Several commenters object to the requirement in § 25.783(e) that provisions for the inspection of door locking mechanisms must be discernable under all possible lighting conditions. The commenters state that allowance should be made for use of supplemental lighting such as a flashlight to aid in the inspection. The FAA agrees and the section is revised accordingly.

A commenter states that direct visual inspection is only needed for external doors for which the initial opening movement is not inward and which are pressurized or for which an inadvertent opening could prevent continued safe flight and landing. Although these comments have merit, they go beyond the scope of Proposal 8-35 and interested parties have not had an opportunity to comment on these changes. No change to the section is being made based on these comments. Several commenters object to the redundancy of a dual warning system requirement and state that in lieu of redundancy, a reliability level should be specified. Further comments state that all external doors do not require this level of reliability. The FAA agrees that this reliability level could be specified and should apply only to external doors for which initial movement is not inward, and the section is changed accordingly. The present language defining where door warning systems are required is retained, as no change in present practice is intended.

A commenter suggests that § 25.783(e) should specify several good design practices. These design practices are desirable but are not essential, since the necessary level of safety can be obtained by alternate means under § 25.783.

Several commenters object to new § 25.783(f), suggesting that it apply only to nonplug type doors and doors whose loss would present a probable hazard. The FAA agrees that provisions to prevent unsafe pressurization can be limited to doors whose loss would present a probable hazard. However, the FAA does not agree that it should be limited to nonplug type doors because a plug door is defined as one whose initial opening is inward and this feature does not necessarily provide complete assurance that an unsafe pressurization will not occur with subsequent opening of the door in flight. The clarifying phrase "to an unsafe level" has been added to § 25.783(f). The intent is to prevent pressurization to a level which would be hazardous if an unlocked external door inadvertently opened.

Several commenters object to proposed new § 25.783(g) (Proposal 8-35), stating that it would unnecessarily preclude the use of nonplug type doors above 45,000 ft. The FAA agrees that nonplug type doors can safely be used at altitudes above 45,000 ft., since adequate warning systems and door integrity are provided by § 25.783(e). Proposed new § 25.783(g) is withdrawn.

A commenter proposes that for the door whose opening would be a hazard, the door and immediate surrounding fuselage, door mechanisms, and warning system be designed for any combination of failures (including improper operation) not shown to be extremely improbable. The FAA agrees. In place of the proposals in 8-30, with regard to §§ 25.365(e) (1), (3), and (4), a rule is included to require determination by safety analysis that inadvertent opening of doors which could prevent continued safe flight and landing is extremely improbable.

Two commenters state that the criteria for passenger egress in the revision to the second sentence of § 25.783(g) (Proposal 2-59 of Notice 75-10) should be evacuation time, and not the rate of passenger egress through a given exit. The FAA agrees. Revision of the second sentence of § 25.783(g) is redesignated as § 25.783(i) and the reference to § 25.561(a) (3) in the proposal is corrected to reference § 25.561(b) (3).

Numerous negative comments concern proposed new § 25.783(j), which requires that lavatory doors open into the cabin to preclude anyone from being trapped in the lavatory. The commenters state that this requirement is overly restrictive on design and that an outward opening door could have an adverse effect on aisle width and emergency evacuation capabilities if such a door jammed open. The FAA agrees that inward opening doors can be designed to prevent anyone being trapped in a lavatory in cases of incapacitation or for other reasons. Thus, new § 25.783(j) is revised to delete the requirement that lavatory doors open into the cabin.

Proposals 8-36, 2-60, and 8-37. Final action on Proposals 8-36, 2-60, and 8-37 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-38. One commenter objects to adding a new § 25.792 to require a sign indicating whether lavatories are occupied, asserting that it would be inappropriate for general aircraft certificated under Part 25. Two commenters doubt that the proposed rule would achieve the objective of preventing aisle congestion near lavatories. They point out that many existing aircraft have similar signs which have not prevented people from "standing in line" for lavatories. Also, passengers can cause congestion in aisles for other reasons. One of the commenters states that lighted signs in a darkened cabin; i.e., during movies or rest periods, would annoy passengers, and that the rule might foster a proliferation of signs throughout the cabin. Finally, one commenter is concerned that any increase in the number of lighted signs might distract the passengers' attention from more essential notices.

Based on the comments and upon further review, the FAA finds that the proposed requirement would not achieve the objective sought. Accordingly, the proposal is withdrawn.

Proposal 8-39. Final action on Proposal 8-39 was taken in Airworthiness Review Program Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-40. Final action on Proposal 8-40 was taken in Operations Review Program Amendment No. 8 (45 FR 41586, June 19, 1980).

Proposal 8-41. A commenter suggests that new § 25.851(a)(5), which replaces current § 25.853(f), be expanded to prescribe four fire extinguishers for a passenger capacity of 100 or more, and to require at least one CO_2, dry chemical, or all purpose fire extinguisher near lavatory and galley areas. These suggested changes are beyond the scope of the notice. However, changes in these requirements are appropriate and the FAA is conducting a research program to establish comprehensive standards and guidance information pertaining to the selection of portable fire extinguishers, taking into consideration types and quantities of extinguisher agents, extinguisher performance, and other factors. Regulatory changes based on the findings of this research program will be proposed in the next airworthiness standards review.

Sections 25.851(a)(5) and (a)(6), which consolidate hand fire extinguisher requirements, are adopted without substantive change.

Proposals 8-42, 2-18, 2-65, 2-114, and 2-160. Final action on Proposals 8-42, 2-18, 2-65, 2-114, and 2-160 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-43. Final action on Proposal 8-43 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-44. For a discussion of proposed § 25.905(c), see the discussion under Proposal 8-103. The proposal to add a new § 25.905(c) is adopted without substantive change.

Proposals 8-45 and 8-96. The proposed amendments to §§ 25.939 and 33.65 are being deferred for consideration in a forthcoming notice of proposed rule making of the Aircraft Engine Regulatory Review Program.

Proposals 8-46, 3-35, and 8-47. Final action on Proposals 8-46, 3-35, and 8-47 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-48. For an explanation of the withdrawal of the proposals concerning automatic takeoff thrust control systems, one of which is the proposal to add a new § 25.1143(f), see Proposal 8-26.

Proposals 8-49 and 3-41. Final action on Proposals 8-49 and 3-41 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-50. For an explanation of withdrawal of the proposals concerning automatic takeoff thrust control systems, one of which is the addition of a new § 25.1305(c)(9), see Proposal 8-26.

One commenter objects to revising § 25.1305(d)(1), stating that significant aerodynamic forces acting on the powerplant nacelle make the direct measurement of thrust impractical. The FAA agrees that such forces may be significant. This commenter further objects to the revision, stating that it is beyond the state of the art to prohibit a parameter from being used if the accuracy of the indication will be adversely affected by any engine malfunction or damage. The FAA agrees that precise values of thrust provided by a malfunctioning, damaged, or deteriorated engine are unnecessary, provided that any changes in thrust due to engine malfunction, damage, or deterioration are indicated to the pilot. The paragraph is revised to require that the indication must be based on the direct measurement of thrust or of parameters that are directly related to thrust.

Although concurring with § 25.1305(d)(1), one commenter states that he would prefer to retain the existing requirements and delete the words ",or to indicate a gas stream pressure that can be related to thrust,". The FAA does not agree. The change suggested by this commenter would eliminate the requirement for thrust information and would retain the requirement for change-of-thrust information only. It also would provide a lower level of safety than the adopted paragraph.

This commenter also states that § 25.1305(d)(1) should be complementary to a similar requirement in Part 33 of this chapter. The FAA does not agree. In current practice, the airframe manufacturer determines how performance should be met. The choice of a means to indicate thrust is negotiated between the airplane manufacturer and the engine manufacturer. The factors which influence the final choice are substantial and may vary among airplane designs. These factors may not be known to the engine manufacturer at the time of engine type certification. Another commenter states that the need for an actual value of thrust is not obvious, whereas indication of a loss of thrust would satisfy the original proposal. The FAA agrees that the actual value of thrust is of little value to the pilot. Section 25.1305(d) (1) is revised to specify that the indicator indicate thrust, or a parameter related to thrust, to the pilot.

Proposal 8-51. No unfavorable comments were received on the proposal to change the reference in § 25.1307(h) for fire extinguishers in connection with Proposal 8-41. Accordingly, the proposal is adopted without substantive change.

Proposal 8-52. Final action on Proposal 8-52 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-53. Several commenters point out a number of service deficiencies with proposed § 25.1421 which defines the requirements for cargo compartment fire detection systems. They contend that the requirement for the detection system to actuate a warning within one minute of the start of a fire is too restrictive. One commenter cites the results of FAA tests which show average fire detection times to be from 1.75 to 5 minutes. The commenters also suggest that the tests necessary to show compliance with the warning requirements are not clearly defined. Finally, one commenter points out that fires in baggage containers and other enclosed containers can burn for a considerable time before detection is likely by fire detectors in the cargo compartment.

The FAA does not concur that the one-minute requirement is too restrictive. A survey of fire detection technology has indicated that the state of the art permits detection of a fire in less than one minute after inception. In addition, current standards do not define the test procedures necessary to show compliance with warning requirements. The new one-minute requirement is intended to improve the standards in this regard.

The proposal is adopted without substantive change.

NOTE: This proposal has been carried erroneously under § 25.1421 which pertains to megaphones. It will be included in the amendment as a new § 25.858.

Proposal 8-54. Comments received from several commenters reflected confusion over the intent of proposed § 25.1439(c). It was noted that much of what was intended by proposed § 25.1439(c) is included in existing § 25.1439(a) as amended by Amendment 25-38 (41 FR 55454; 12/20/76), provided that the portable oxygen requirements of § 25.1447(c) (4) are retained. Amendment 25-38 emanated from Airworthiness Review Program Notice No. 2 (40 FR 10813; 3/7/75), and was adopted (41 FR 55468; 12/20/76) after publication of Airworthiness Review Program Notice No. 8 (40 FR 29420; 7/11/75) which contained proposals 8-54 and 8-55. The FAA agrees that the existing regulations require much of what was intended by proposal 8-54, provided that proposal 8-55 is withdrawn. The FAA further agrees that additional clarifications are needed before further amendments are made to § 25.1439. Therefore the FAA withdraws both proposals 8-54 and 8-55. The subject of protective breathing equipment will be addressed in a forthcoming notice of proposed rule making.

Proposal 8-55. The proposal to delete § 25.1447(c) (4) is withdrawn for the reasons stated for withdrawal of Proposal 8-54.

Proposal 8-56. For comments related to the proposal to revise § 25.1521(a), and for the withdrawal of that proposal, see Proposal 8-94.

Proposal 8-57. Final action on Proposal 8-57 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-58. For comments related to the proposal to amend § 25.1529, see Proposal 8-21.

Proposal 8-59. A commenter objects to the proposed new § 25.1557(e), calling for a placard on each flight attendant seat to indicate that it may be occupied by a flight attendant, asserting that such placarding is redundant and that a proliferation of placards in the aircraft will only serve to confuse the passengers and make all placards less effective. The commenter also states that the proposal would prohibit non-flight attendant airline personnel who are cognizant of emergency procedures from occupying flight attendant seats when the aircraft is full. The FAA concludes that a new aircraft certification rule is unnecessary to achieve this result and the proposal is withdrawn.

Proposals 8-60 and 8-61. Final action on Proposals 8-60 and 8-61 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 7-55. A commenter recommends that discrete gusts with varying gradient distances be added as a supplement to Appendix G to Part 25. The FAA disagrees because past experience with the use of discrete gusts with varying gust gradient distances has indicated that knowledge with regard to how gust intensity varies with gust gradient distance is not currently available to the designer. The research and development work accomplished in the area of dynamic response to continuous turbulence has indicated that the continuous turbulence criteria of Appendix G to Part 25 is the most rational approach currently available which gives consistent strength levels for airplanes of different characteristics and missions.

A commenter recommends that paragraph (a) of Appendix G be revised to delete the requirement for considering combined stresses based on both vertical and lateral components of turbulence. The commenter states that the current practice of combining root-mean-square stresses (shear, moment, and torsion) resulting from gust calculations involving only purely vertical or lateral components of turbulence is a realistic, practical method for combining stress. The commenter contends that the methods for realistically combining statistical load quantities involving both vertical and lateral components of turbulence have not been satisfactorily developed in the current state of the art. After further review the FAA agrees. Paragraph (a) of Appendix G is revised to delete the requirement for considering the combined stresses resulting from the vertical and lateral components of turbulence.

A commenter recommends that paragraph (b)(3)(i) of Appendix G be revised to require a gust intensity of $U_\sigma = 75$ fps gust velocity in the interval 0 to 20,000 ft. altitude with a linear decrease to 30 fps at 80,000 ft. altitude. This recommendation would obviate the need to do mission analysis to justify lower levels of loads than those required to meet the design envelope gust intensity factor of 85 fps for new airplanes whose characteristics are similar to previous designs which have been shown to be adequate for the lower level of gust intensity being proposed. There is no technical need for new aircraft which are similar to existing aircraft with regard to response characteristics and basic mission profiles to make extensive mission analysis computations in order to establish their adequacy with regard to loads resulting from encounters with continuous turbulence if they are designed for the gust intensity shown to be adequate for the existing design. Therefore, it is acceptable to use a gust intensity value of 75 fps from 0 to 20,000 ft. altitude, and a linear reduction from 75 fps at 20,000 ft. to 30 fps at 80,000 ft., provided the new design is comparable to a similar design with extensive satisfactory service experience. These criteria, which have been under discussion between FAA and industry for over 10 years, are proposed as new rules rather than acceptable means of complying with existing rules. Paragraph (b)(3)(i) is revised accordingly. The commenter also recommends that paragraph (d)(1) be revised to require a gust intensity of $U_\sigma = 60$ fps on the interval 0 to 20,000 ft. altitude and be linearly decreased to 23 fps at 80,000 ft. altitude. The FAA disagrees. The gust intensities in paragraph (d)(1) are based on the distribution of gust intensity with altitude which were developed in the basic research for the development of continuous turbulence criteria and are, therefore, considered reasonable as a lower design envelope limit for mission analysis. A cost analysis was provided by the commenter to justify the lower gust intensities, but the FAA finds that this cost analysis was based on "design envelope analysis" alone. Paragraph (c), which is an alternative to paragraph (b), provides for a "mission analysis". Actual experience has shown that "mission analysis," which considers airplane operational characteristics, has been used in the past in lieu of the 85 fps intensities to prevent weight and cost penalties. Paragraphs (c) and (d) of Appendix G are adopted without substantive change.

A commenter recommends that paragraph (d) of Appendix G be revised to delete the reference to "fail-safe loads" since such loads are not provided in Appendix G. The FAA agrees. Paragraph (d) of Appendix G is revised accordingly.

A commenter recommends that proposed paragraph (e) of Appendix G be deleted since acceleration levels measured at the pilot station on current conventional aircraft can be established by flight demonstration much more easily and with less cost than by use of an expensive analysis considering response to continuous turbulence. Upon further review, the FAA has determined that it lacks sufficient information to specify the right combination of analysis and flight test to determine the acceleration levels at the pilot's station during continuous turbulence. Accordingly, proposed paragraph (e) of Appendix G is withdrawn. The current requirements related to operation in turbulence are adequate to determine the response at the pilot's station during continuous turbulence.

Proposal 8-62. For comments related to the proposal to add a new Appendix G to Part 25, see Proposal 8-25. Appendix G (redesignated Appendix H) to Part 25 is adopted with the changes discussed in Proposal 8-25.

Proposal 8-63. Final action on Proposal 8-63 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Amendment to § 27.571. Because of the change to § 25.1529 adopted in this amendment, the reference to § 27.1529(a) (2) in §§ 27.571(b), (c), (d) (1), (d) (3), and (e) is no longer appropriate. The reference is changed to "§ A27.4 of Appendix A". This discrepancy was overlooked in Notice 75-31 (40 FR 29410; July 11, 1975). Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 8-64. For comments related to the proposal to amend § 27.1529, see Proposal 8-21.

Proposals 8-65 and 8-66. Final action on Proposals 8-65 and 8-66 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-67. For comments related to the proposal to add a new Appendix A to Part 27, see Proposal 8-25. Additional comments on this proposal, and on the proposal to add a new Appendix A to Part 29, are discussed here.

A commenter suggests that the wording of Appendix A be adjusted to take into account the differences between airplanes and rotorcraft. The FAA agrees. The appendix, as proposed, is generally equally applicable to airplanes and rotorcraft. However, several minor changes have been made to the appendix to provide for rotorcraft differences, primarily to cover rotors and differing fatigue standards.

A commenter objects to Appendix A, contending that: (1) The standards in current §§ 27.1529 and 29.1529 have been adequate in service, and (2) the proposal is excessive in scope and would create an undue burden. The FAA does not agree, having found that recommended maintenance procedures made available to operators/owners in the past were frequently inadequate in scope and content, providing no sound basis for maintaining the airworthiness of the rotorcraft. Appendix A, with the revisions and deletions discussed above and under Proposal 8-25, would not create an undue burden on the type certificate applicant.

One commenter expresses concern that certain inspection provisions in current § 91.217 might be applied to rotorcraft. The appendix contains no such requirement. Current § 91.217 applies only to certain airplanes.

Amendment to § 29.571. Because of the change to § 29.1529 adopted in this amendment, the reference to "§ 29.1529(a) (2)" in §§ 29.571(b), (c), (d) (1), (d) (3), and (e) is no longer appropriate. For consistency, the reference is changed to "§ A29.4 of Appendix A required by § 29.1529". This change was overlooked in Notice 75-31 (40 FR 29410; July

11, 1975). Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 2-154. For a discussion directly related to proposed new § 29.783(g), see the discussion under Proposal 8-35 for § 25.783(g) (Proposal 2-59 of Notice 75-10). Section 29.783(g) is adopted without substantive change.

Proposals 8-68 through 8-76 and 2-164. Final action on Proposals 8-68, 8-69, 8-70, 8-71, 8-72, 8-73, 8-74, 8-75, 8-76, and 2-164 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-77. For comments related to the proposal to amend § 29.1529, see Proposal 8-21.

Proposals 8-78 and 8-79. Final action on Proposals 8-78 and 8-79 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-80. For comments related to the proposal to add a new Appendix A to Part 29, see Proposals 8-25 and 8-67.

Proposal 8-81. No unfavorable comments were received on adding a new § 31.12 providing for standardized application of the airworthiness requirements for balloons. Accordingly § 31.12 is adopted without substantive change.

Proposal 8-82. No unfavorable comments were received on adding a new § 31.16 requiring that balloon empty weight be determined. Accordingly, § 31.16 is adopted without substantive change.

Proposal 8-83. No unfavorable comments were received on the intent of new § 31.17 which specifies performance in terms of an initial minimum rate of climb. However, a commenter raises the question whether compliance with proposed § 31.17(a) could be shown by testing at several altitudes and ambient temperatures and then extrapolating, by appropriate analysis, to the other values in the range for which approval is sought. The FAA considers that such extrapolation by analysis is an acceptable means of complying with proposed § 31.17(a), because the climb performance of balloons is based on fundamental principles and, therefore, can be predicted with sufficient accuracy from established test points.

The FAA notes that the 300 fpm climb rate requirement in § 31.17(a) was intended as a minimum standard. To make this clear, § 31.17 as adopted is revised by inserting the words "at least" before the number "300" in the first sentence of § 31.17(a).

Proposal 8-84. A commenter, referring to new § 31.19(a) governing critical uncontrolled descent, suggests that it would be difficult and time-consuming to determine which tear is the most critical single tear in the balloon envelope between tear stoppers. The FAA does not agree. An analysis, or a combination of test and analysis, would be an acceptable means of determining the most critical single tear. It would not be necessary to test each kind of tear. No other unfavorable comments were received on the proposal to add a new § 31.19. Accordingly, § 31.19 is adopted without substantive change.

Proposal 8-85. No unfavorable comments were received on the proposal to amend § 31.27(c) to be consistent with new § 31.19, Performance: Uncontrolled descent. Accordingly, the proposal is adopted without substantive change.

Proposal 8-86. No unfavorable comments were received on the proposal to amend § 31.65 updating the position light standards and expressing them in language consistent with related standards in other airworthiness parts. However, the FAA finds that the use of a cross reference to § 23.1397 as proposed in § 31.65(e) may be inconvenient for those governed by Part 31. Accordingly, § 31.65, as adopted, sets forth the chromaticity coordinates for aviation red and aviation white as currently prescribed in § 23.1397.

Proposal 8-87. No unfavorable comments were received on the proposal to amend § 31.71. However, after further consideration, the FAA concludes that proposed § 31.71(a) (2) is unnecessarily restrictive in that it would, in all cases, require marking the equipment as to its identification, function, *and* operating limitations. Marking of the equipment as to its identification, function, *or* operating limitations, or any applicable combination of those factors is sufficient. This is also the language used in corresponding sections of other aircraft airworthiness regulations. Section 31.71, as adopted, is revised accordingly.

Proposal 8-88. No unfavorable comments were received on the proposal to amend § 31.81 to detail operating limitations and information. The FAA notes, however, that proposed § 31.81(b) is not clear as to which "operating limitations and other information necessary for safe operation" must be furnished. The FAA's intent, as stated in the explanation, is to require that the information established under § 31.81(a) be furnished. Section 31.81(b) is revised accordingly. Section 31.81(a) is adopted without substantive change.

Proposal 8-89. A commenter is concerned that proposed § 31.82 might require balloon manufacturers to prepare two overlapping maintenance documents—the maintenance manual currently supplied to operators/owners, and the proposed Instructions for Continued Airworthiness. The FAA notes that under §§ 31.82 and 21.50(b), balloon manufacturers would be required to prepare and furnish only the Instructions for Continued Airworthiness.

The FAA notes further (as discussed under Proposal 8-21) that the Instructions for Continued Airworthiness need not be finalized until delivery of the first balloon, while § 31.82, as proposed, could be interpreted to require that they be finalized before type certification. This point is clarified in § 31.82, as adopted, consistent with the corresponding requirement in Parts 23, 25, 27, and 29.

Proposal 8-90. No unfavorable comments were received on the proposal to amend § 31.85(b)(1). However, a commenter questions whether percentage figures on the required fuel quantity gauge would be acceptable. The FAA has determined that, in the particular case of balloons (for which the fuel quantity information is to an extent less important to safety than for other classes of aircraft), calibration of the fuel quantity gauge in percent of fuel cell capacity is an acceptable means of complying with the last sentence of § 31.85(b)(1). Section 31.85(b)(1), as adopted, is revised to make this clear.

Proposal 8-91. No adverse comments were received on the proposal to add a new Appendix A to Part 31. However, comments received on the proposals to add a similar appendix to Parts 23, 25, 27, and 29 (Proposal 8-25), were equally valid with respect to this proposal. Accordingly, Appendix A to Part 31, as adopted, is revised in substance as applicable.

Regarding the proposals to require generalized repair data in the Instructions for Continued Airworthiness, it is more appropriate, as well as necessary and practicable, to include specific instructions for repair of the key elements of a balloon—the balloon envelope and its basket or trapeze. This information is incorporated in paragraph A31.3(i) as revised.

Proposal 8-92. A commenter objects to § 33.4 insofar as it would require completion of the Instructions for Continued Airworthiness before the type certificate is issued, contending that a significant portion of the data and other material called for is typically not compiled until 6 months or longer after type certification. The commenter suggests that manufacturers be allowed to prepare and make available the Instructions for Continued Airworthiness before the first aircraft equipped with the subject engine is put into service, which, it claims, is the earliest such instructions would be needed. Requiring the engine manufacturer to complete the Instructions for Continued Airworthiness before the type certificate is issued would constitute an unnecessary burden. However, the FAA considers that they must be made available, and furnished, upon delivery of the first engine on an aircraft or issuance of a standard certificate of airworthiness for the aircraft, whichever occurs later. This would be consistent with corresponding requirements proposed for other products. See Proposals 8-5 and 8-21. Section 33.4 is revised and adopted accordingly.

Proposal 8-93. A commenter observes that § 33.5 requires that the instruction manual for installing and operating the engine be "approved," whereas proposed § 33.4 requires that the Instructions for Continued Airworthiness be "acceptable to the Administrator," and recommends that the latter term be used for consistency. The FAA notes that the term "acceptable to the Administrator" is widely used in Part 43 in connection with maintenance requirements, whereas the term "approved" is more frequently used in FAR Parts containing installation and operating requirements. Considering the FAR as a whole, the FAA does not agree that such consistency is essential. Accordingly, § 33.5 is adopted as proposed.

Proposal 8-94. Several commenters object to proposed §§ 33.6(e) and (f), and to proposed §§ 23.1521(a) and 25.1521(a) (Proposals 8-20 and 8-56, respectively) on the grounds that the use of rated takeoff power or thrust for 10 minutes with one engine inoperative should not be limited to "the extent that the utilization is necessary for the airplane to avoid, without necessitating turning maneuvers, obstacles beneath the flight path intended for the airplane prior to the loss of the engine." In light of these comments and after further review, the FAA concludes that these proposals are premature and they are withdrawn.

In addition, the proposed transfer of the definitions for rated power and thrust from § 1.1 to proposed new § 33.6, Proposal 8-1, is withdrawn since the transfer may cause confusion in the administration of the aircraft certification requirements. Accordingly, Proposals 8-1, 8-20, 8-56, and 8-94 are withdrawn.

Proposal 8-95. For discussion of proposed § 33.19(b) see the discussion under Proposal 8-103. Revised § 33.19 is adopted without substantive change.

Amendment to §§ 33.55(c), 33.57(b), 33.93(b), and 33.99(b). Because of the deletion of §§ 33.5(c), (d), and (e), and the addition of a new § 33.4, the reference to "§ 33.5" in §§ 33.55(c), 33.57(b), 33.93(b), and 33.99(b) is no longer appropriate. For consistency, the reference is "§ 33.4." This change was inadvertently overlooked and was not proposed in Notice 75-31 (40 FR 29410; July 11, 1975). This editorial change corrects that discrepancy. Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 8-97. A commenter recommends that § A33.3(a)(6) of Appendix A to Part 33 be revised by adding the words "requiring periodic attention" so as to make it clear that scheduling information is required solely for parts that require such attention. The language in this section is adequate. For parts not needing periodic attention, the applicant has only to state that parts not scheduled need not be serviced.

A commenter infers incorrectly that proposed §§ 43.16 and 91.163(c) apply only to rotorcraft. These regulations with the revision proposed also affect other classes of aircraft, as well as engines and propellers.

Some comments received on the proposed appendices for Parts 23, 25, 27, and 29 (Proposal 8-25) were equally valid with respect to proposed Appendix A to both Parts 33 and 35. Accordingly, the appendices to Parts 33 and 35 are revised in substance as applicable.

Proposal 8-98. For a discussion related to proposed § 35.3 see Proposal 8-93. A commenter observes that § 35.3 requires that the instruction manual for installing and operating the propeller be "approved," whereas § 35.4 requires that the Instructions for Continued Airworthiness be "acceptable to the Administrator," and recommends that the latter term be used for consistency. The FAA notes that the term "acceptable to the Administrator" is widely used in Part 43 in connection with maintenance requirements, while the term "approved" is more frequently used in FAR parts containing installation and operating requirements. Considering the FAR as a whole, the FAA does not agree that consistency is required in this instance. Accordingly, § 35.3 is adopted as proposed.

Proposal 8-99. In response to the concern of a commenter representing a number of Part 121 operators, the FAA notes that there is no requirement that any operator/owner use the Instructions for Continued Airworthiness referred to in proposed § 35.4. The new §§ 43.13(a), 43.16, and 91.163(c) allow the use of other methods. In particular, the use of maintenance manuals and continuous airworthiness maintenance programs developed under Parts 121, 123, 127, and 135, or an inspection program approved under § 91.217(e) would be acceptable alternatives to the Airworthiness Limitations section. This commenter suggests that language be added to proposed § 35.4 to make it clear that such alternatives may be used. The FAA agrees. The language in §§ 43.16 and 91.163(c) is revised accordingly.

Consistent with the discussion on proposed § 33.4 dealing with engines (see Proposal 8-92), the FAA finds that requiring the propeller manufacturer to complete the Instructions for Continued Airworthiness before the type certificate is issued would constitute an unnecessary burden. Accordingly, § 35.4 as adopted, requires that those instructions be made available and furnished upon delivery of the first aircraft with the propeller installed, or upon issuance of a standard certificate of airworthiness for an aircraft with the propeller installed, whichever occurs later.

Proposal 8-100. No unfavorable comments were received on the proposal to amend § 35.5 to more clearly indicate the basis for operating limitations and where they are listed. Accordingly, § 35.5 is adopted without substantive change.

Proposal 8-101. No unfavorable comments were received on the proposal to amend § 35.23 to provide an extreme low pitch indication. Accordingly, § 35.23 is adopted without substantive change.

Proposal 8-102. A commenter does not concur with the proposal to revise § 35.37 to require evaluation of metallic hubs and blades, stating that the words "must", "all", and "reasonably foreseeable" in the second sentence imply responsibility beyond current knowledge and the state of the art. The FAA does not agree. These terms are used in the current rule and the current state of the art defines the limits of the provision.

The same commenter recommends that § 35.37 be revised to apply to consideration of "normal and reasonably foreseeable load patterns," to account for the fact that only normal operations will or should be considered. The FAA does not agree. Load patterns which are reasonably foreseeable are critical and should be investigated even if they are not normal.

The same commenter also indicates that the third sentence should be revised to eliminate the term "reduction factors," since reduction factors are identified with only one particular method of presentation. The FAA agrees and the section is revised accordingly. This commenter finally states that the explanation implies that manufacturers have not taken permissible damage and material variation into account. This implication is not intended. It is the FAA's view that the fatigue evaluation should consider the occurrence of typical service damage and variation in material properties and the rule would provide for such an evaluation.

Another commenter suggests that the section be revised by adding certain technical requirements that are related to infinite component life. It is not necessary to specify requirements concerning infinite component life, since they are considered a normal part of propeller fatigue testing.

Section 35.37 is adopted as revised.

Proposal 8-103. A commenter objects to the proposal to add a new § 35.42 to define durability requirements for propeller blade pitch control system components, stating that the term "bench tests" in §§ 35.42(a) and (b) is too descriptive and restrictive. The FAA agrees that a reference to "bench tests" may be too restrictive. Other test methods may be equally acceptable in providing the necessary data. Accordingly, §§ 35.42(a) and (b) are revised to eliminate the specific reference to "bench."

The commenter also suggests that the words "in frequency and amplitude" be eliminated from § 35.42(a) since the words "cyclic testing" are fully descriptive. The FAA believes that these words are needed to prescribe key elements in the required test.

The commenter further suggests that the proposed testing to the equivalent of 1,000 hours of propeller operation is too restrictive in the case of a propeller with an overhaul period of less than 1,000 hours. The FAA considers the specific testing to be the minimum necessary to provide an acceptable safety level in service. The rule does not, however, prevent the selection of overhaul intervals of less than 1,000 hours.

Finally, the commenter suggests that the rule should permit an alternate of acceptance based upon service experience. The FAA recognizes that service experience can provide a statistical basis for determining component reliability. Its applicability, however, may vary according to such considerations as type of operation, the nature of the article under consideration, the degree of similarity between the reference article and the certification article, and the completeness of service records. Since it is dependent on such a variety of factors, the FAA does not agree that a specific alternative based on service experience should be included.

The proposal to add a new § 35.42, therefore, is adopted with the change discussed below. No adverse comments were received on the related proposed revisions to §§ 23.905, 25.905, and 33.19 to add the reference to new § 35.42, and the revisions are adopted.

Proposal 8-104. For comments related to the proposal to add a new Appendix A to Part 35, see Proposals 8-25 and 8-97.

A commenter objects to proposed § A35.1(c) of the appendix because the propeller owner (aircraft operator) would be wastefully provided with instructions and data that the propeller owner has no authority to use. The FAA does not agree. The Instructions for Continued Airworthiness must be furnished to the aircraft owner/operator who is the person responsible for maintaining the aircraft (including the propeller). The owner/operator may not be authorized to maintain the propeller, but the owner/operator can place the instructions in the hands of persons who are authorized.

The new Appendix A to Part 35, as adopted, is revised in accordance with comments discussed in Proposal 8-97.

Proposal 8-105. The proposed revision of § 43.9(a)(4) is being deferred for consideration in a forthcoming notice of proposed rule making of the Operations Review Program.

Proposal 8-106. A commenter representing a number of scheduled air carriers is concerned that the use of maintenance manuals and continued airworthiness programs developed under current § 121.133 and Subpart L of Part 121 (generally via Maintenance Review Board procedures), or under similar provisions of Parts 127 and 135, might not be acceptable as "other methods, techniques, and practices" under the terms of proposed § 43.13(a). This commenter suggests that language be added to proposed § 43.13(a) to make this clear. The FAA does not agree. The proposed language states that the use of such manuals and continued airworthiness programs is acceptable.

Proposal 8-107. A commenter representing a number of scheduled air carriers recommends that the Airworthiness Limitations section referred to in proposed § 43.16 include life limitations only and not inspections or other maintenance items. As discussed under Proposal 8-3, the FAA does not agree.

A commenter suggests that the words "or other methods, techniques; and practices acceptable to the Administrator" be added at the end of proposed § 43.16 to make it consistent with proposed § 43.13(a). The Airworthiness Limitations section contains specific mandatory replacement times and inspection intervals (with related procedures) that must be complied with, unless it can be shown by an operator with an approved maintenance program that these times are inappropriate for his operation. The use of alternatives not covered in the Airworthiness Limitations section would be allowed if approved by the Administrator. Section 43.16 is revised to specifically state the alternatives to compliance with the Airworthiness Limitations section.

Proposal 8-108. No unfavorable comments were received on the proposal to amend § 45.11 to qualify, with respect to manned free balloons, the requirements in § 45.11(a) that deal with the location of the identification plate. Accordingly, the proposal is adopted without substantive change.

Proposal 8-109. No unfavorable comments were received on the proposal to amend § 45.13 to correctly reference §§ 45.11(a) and (b) with regard to identification plate requirements. Accordingly, the proposal is adopted without substantive change.

Proposal 8-110. A commenter representing a number of scheduled air carriers recommends that the words "inspection interval, or related procedure" be deleted from proposed § 45.14. The supporting rationale is the same as submitted by this commenter concerning Proposal 8-3 to amend § 21.31(c). As discussed under Proposal 8-3, the FAA disagrees.

The language in § 45.14 covers rotorcraft as well as airplanes, balloons, engines, and propellers. To make this clear, the word "Rotorcraft" is changed to "Manufacturer's".

Two commenters object to proposed § 45.14 on the grounds that it would be impracticable to mark small parts with a part and serial number. The FAA is not aware that the marking of small parts under current § 45.14 has presented a problem. In any event, the rule allows markings that are equivalent to part and serial numbers, such as symbols enabling the identification of the part as one for which a replacement time, inspection interval, or related procedure is specified in an Airworthiness Limitations section. Identification of such parts is clearly essential for safety. Accordingly, § 45.14 is adopted as revised.

Proposal 8-111. A commenter representing a number of scheduled air carriers recommends that the words "inspection interval, or related procedure" be deleted from proposed § 91.163(c). The supporting rationale is the same as that submitted by this commenter concerning Proposal 8-3 to amend § 21.31(c). As discussed under Proposal 8-3, the FAA disagrees. However, § 91.163(c) is revised to specifically identify the acceptable alternatives to compliance with the "Airworthiness Limitations" section.

The language in proposed § 91.163(c) covers rotorcraft as well as airplanes, balloons, engines, and propellers. To make this clear, the word "Rotorcraft" in § 91.163(c) has been changed to "Manufacturer's", and a statement has been added that operations specifications approved by the Administrator may be used in lieu of the Instructions for Continued Airworthiness. Section 91.163(c) is adopted as revised.

Proposal 8-112. No unfavorable comment was received on the proposal to amend § 91.165 to clarify maintenance personnel entries in maintenance records. Accordingly, the proposal is adopted without substantive change.

Proposal 8-113. Several commenters object to §§ 91.173(a)(2)(i) and (iii). A commenter states that adoption of the proposal would result in an inconsistency between § 91.173 and § 121.380, which contains the recordkeeping requirements for aircraft maintained under Part 121. The commenter also states that this inconsistency would cause great difficulty and economic hardship whenever an aircraft is sold by a Part 121 operator to a Part 91 operator and the Part 91 aircraft is maintained by a Part 121 operator under its repair station certificate. According to the commenter, the economic hardship would occur to both the Part 91 operator and the repair station. The same commenter contends that reliability information accumulated in recent years on transport category airplanes shows that there is no need for individualized total time records on equipment and components. Another commenter states that proposed requirements would result in large increases in maintenance costs for Part 91 operators and that only those components that are life-limited should have to carry total times.

The FAA concludes, however, that revision of § 91.173(a)(2)(i) would contribute significantly to safety with little burden on those affected. The currently prescribed record of total time in service for the airframe does not generally apply to the aircraft's engines or propellers, since these components are frequently overhauled (or replaced) at different times. As a practical matter, it is known that operators of such aircraft normally keep records from which the total time in service of engines and propellers can be derived. Therefore, the FAA does not agree that the requirement to keep total times on engines and propellers would be a hardship and burden upon the operators. Accordingly, § 91.173(a) (2) (i) is adopted without change.

In light of the comment on proposed § 91.173(a) (2) (iii), the FAA has given further review of the proposal and has concluded that existing requirements satisfy the objective of the proposal. Accordingly proposed § 91.173(a) (2) (iii) is withdrawn.

The reporting and recordkeeping requirements contained in § 91.173 have been approved by the Office of Management and Budget in accordance with the Federal Reports Act of 1942.

Proposal 8-114. Several commenters agree with the intent of proposed § 91.193(c) (4) but suggest changes. A commenter suggests that the proposed installation instructions for hand fire extinguishers would be more appropriately placed in the type certification rules. The FAA does not agree. New type certification rules do not apply to aircraft already in service.

A commenter suggests that the words "unless obvious" be added to clarify when the hand fire extinguisher stowage provisions must be properly identified. The FAA agrees. Proposed § 91.193(c) (4) is revised and adopted accordingly.

Proposal 8-115. One commenter objects to the proposal to revise § 91.197(a) to require passenger information signs to meet the requirements of § 25.791. The commenter states that it is unnecessary, in many small general aviation aircraft operating under Subpart D of Part 91, to have such signs just for the sake of uniformity. The commenter also states that "nonstandard" signs now in use are wholly adequate to meet the needs of the type of operation. Finally, the commenter points out that installation costs for aircraft not currently having signs would be high and the pilot could just as easily announce the information as he could activate the signs.

Based on these comments and considering the type of operation involved, the FAA finds that the benefits associated with the proposal do not warrant its adoption. The proposal to revise § 91.197(a) is withdrawn.

Proposals 8-116, 8-117, 8-118, and 8-119. Final action on Proposals 8-116, 8-117, 8-118, and 8-119 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-120. In light of the need to conduct further testing of protective breathing equipment, the FAA withdraws its proposal to amend § 121.337, which will be addressed in an upcoming notice of proposed rule making.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 11, 21, 23, 25, 27, 29, 31, 33, 35, 43, 45, and 91 of the Federal Aviation Regulations are amended, effective October 14, 1980.

(Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C.1354(a), 1421, 1423, and 1424)); and Section 6(c) of the Department of Transportation Act (49 U.S.C.1655(c)))

The FAA has determined that this document involves a regulation which is not significant under Executive Order 12044, as implemented by Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final evaluation prepared for this document is contained in the docket. A copy of it may be obtained by writing to the individual and address listed in the "For Further Information Contact" paragraph.

Amendment 25-55

Miscellaneous Amendments

Adopted: February 26, 1982 **Effective: April 28, 1982**

(Published in 47 FR 13312, March 29, 1982)

SUMMARY: These amendments make a number of minor changes to the Federal Aviation Regulations (FAR). They amend certain Parts to change prerequisites required for flight tests and the experience necessary for an airline transport pilot certificate. They change the validity period for the written test for a flight engineer certificate. In addition, they amend certain sections of the FAR by changing the word aircraft to airplane. Part 45 of the FAR is amended to permit an approved parts manufacturer to refer, on a tag, to readily available information when it would be impractical to mark the required eligibility information on the tag. Part 91 of the FAR is amended to delete the list of purposes for which a special flight authorization for foreign civil aircraft may be issued. Other sections are amended for purposes of clarification or correction.

FOR FURTHER INFORMATION CONTACT: Mr. E. Wendell Owens Regulatory Review Branch (AVS-22), Safety Regulations Staff, Associate Administrator for Aviation Standards, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591, Telephone (202) 755-8714.

SUPPLEMENTARY INFORMATION:

Background

A number of these amendments address problems in the FAR which have been highlighted by numerous requests for exemptions and extensions of compliance dates. In addition, several areas in the FAR require interpretation and clarification. The remaining changes are editorial.

Generally, these amendments address unrelated items that have accumulated over recent years and are appropriate for consolidation in a miscellaneous amendment package.

Discussion of Comments

The following discussions are keyed to like-numbered proposals contained in Notice 80-23 (45 FR 80450; December 4, 1980).

Proposal 1. The proposal to amend § 21.197 to make Part 135 operators eligible for special flight permits with continuing authorizations was disposed of separately in Amendment 21-54 (46 FR 37876; July 23, 1981).

Proposal 2. This proposal would correct an incomplete listing of sections. The correct sections are listed in Appendix A, Section A23.1(a), as §§ 23.321 through 23.459. No comments were received on this proposal. Accordingly, the proposal is adopted without substantive change.

Proposals 3 and 9. Sections 23.305(a) and 25.305(a) contain parallel requirements for structural strength and deformation; however, these include differences in wording and punctuation from the corresponding statements contained in the similar, but correctly stated §§ 27.305(a) and 29.309(a). These proposals would correct §§ 23.305(a) and 25.305(a) by making them consistent with §§ 27.305(a) and 29.305(a). One commenter points out that the word "or" was erroneously inserted at the time CAR 6 and 7 were recodified to Parts 27 and 29 of the FAR. The commenter further states that §§ 23.305 and 25.305 are correctly stated, and that §§ 27.305(a) and 29.305(a) (which have the word "or" inserted) should be revised accordingly.

As originally written, the word "detrimental" was used to quantify the amount of permanent deformation and prohibit acceptance of a loading test which resulted in deforming the tested article to an extent that would degrade its structural charateristics. Insertion of a comma or a conjunction between "detrimental" and "premanent" would change the intended meaning. Inasmuch as the proposed change would only add to the error, the proposals to amend §§ 23.305 and 25.305 are withdrawn.

Proposal 4. This proposal would rearrange paragraphs (a)(1), (a)(2), and (a)(3) of § 23.441 to ensure that the correct tail load distribution is imposed for the flight condition. One commenter points out that the desired correct correlation between load specifying figures in Appendix B and the alternate load requirements of §§ 23.441(a), (b), and (c) could also be accomplished by leaving (a)(1), (a)(2), and (a)(3) in their present order while changing B6, B7, and B8 to B7, B6, and B8. Inasmuch as the interchange of the numbers 6 and 7 occurred initially when the prefix letter B was added in Amendment No. 23-7, August 13, 1969, and because other printings of Part 23 use the order B7, B6, and B8, the FAA disagrees with the commenter. Accordingly, the proposal is adopted without substantive change.

Proposal 5. This proposal would amend § 23.472(f) to delete reference to § 23.725 and insert the reference to § 23.723(a) in its place. This proposal would permit drop tests other than the free drop tests, and would make the requirement consistent with corresponding sections of Parts 25, 27, and 29. No comments were received on this proposal. Accordingly, the proposal is adopted without substantive change.

Proposal 6. No comments were received on the proposal to insert the word "red" before the word "arcs" in § 23.1549(d), for consistency with § 25.1549(d). The proposal is adopted without substantive change.

Proposal 7. This proposal would correct a reference to § 23.201(b) in § 23.1587(a)(1).

The reference to § 23.201(a) or (b) in § 23.1587(a)(1) is incorrect. Reference to § 23.201(a) as proposed in Notice 80-23 is also incorrect. Both references are for paragraphs dealing with control configurations. Section 23. 201(c) deals with a maneuver as intended in § 25.1587(a)(1).

Two commenters suggest that the altitude loss information required by § 23.1587(a)(1) should be required for all airplanes regardless of whether or not they have independent controls. The FAA agrees and has amended § 23.1587(a)(1) to reference § 23.201(c) which applies to all airplanes regardless of their control configuration. The section is amended accordingly.

Proposal 8. This proposal would correct errors contained in the equation constants noted under A23.3, Special Symbols.

No comments were received on the proposal to correct the numbers in the velocity equations which will then correctly reflect the change from miles per hour to knots. This proposal is adopted without substantive change.

Proposal 10. This proposal would amend § 25.807 to make it clear that all transport category aircraft must have ditching emergency exits whether or not ditching certification is requested.

One commenter objects to the application of the ditching (emergency exit) requirement to all Part 25 and Part 29 aircraft. The commenter states that the ditching provisions of §§ 25.807 and 29.807 do not apply unless requested. This commenter also directs attention to Notice 80-23 which solicits economic information on these regulations.

Another commenter expressed full support of the proposal. This proposal is intended to clarify the existing regulation and does not establish a new requirement for transport category airplanes. Accordingly, the proposal is adopted without substantive change.

Proposal 11. No comments were received concerning these proposed minor editorial changes. Accordingly, the proposal is adopted without substantive change.

Proposal 12. This proposal would amend § 29.807 to make it clear that all transport category aircraft must have ditching emergency exits whether or not ditching certification is requested.

A commenter states that helicopters not certified for ditching will probably capsize immediately when rotor lift is lost because of their high center of gravity and lack of lateral stabilizing appendages such as wings. This commenter also claims that, because of the additional factor that compartments are not usually water-tight, it is impossible to determine a waterline. The commenter recommends the proposal be cancelled.

Two commenters strongly object to this proposal on the basis that the extension of the transport airplane condition to a helicopter is illogical because of the unique characteristics of helicopters. The commenters point out that the FAA previously considered this question and agreed that the proposed requirement was inappropriate.

Since the time this question was previously considered, there has been no new evidence which would justify a change in rationale, nor has there been any new evidence pointing to a need for added rotorcraft ditching exit provisions. Accordingly, this proposal is withdrawn.

Proposal 13. This proposal would have made Part 43 internally consistent by amending § 43.4 to include Canadian persons authorized under § 43.17. Operations Review Program Notice No. 12 proposes changes to § 43.3. Accordingly, this proposal is withdrawn and will be acted upon as part of that review. Comments received in response to this proposal will be given full consideration in that action.

Proposal 14. Two comments were received in response to this proposal to revise the marking requirements of § 45.15 so that when it is impractical to mark the required eligibility information on the tag attached to a part or container, the tag may refer to a specific and readily available reference manual or catalog which contains the required information.

One comment was submitted by the Industry Association that petitioned for this rule change. It found the wording of this proposal to be reasonable.

Another commenter believed that the original concept of Parts Manufacturer Approvals (PMA) was primarily based on the production of parts such as spark plugs, pistons, piston pins, etc., to be used as duplicate parts without a specific part number. These parts are, in fact, required to have a specific part number. Further, the PMA manufacturer is required to mark the parts (or tags) with parts replacement eligibility. It was not proposed to remove the requirement for this information from § 45.15; it was proposed to provide that, in those cases where it would not be practical to mark the required eligibility information on the tag, the tag may contain a reference to a readily available manual or catalog containing the required eligibility information.

Section 45.15 is adopted without substantive change.

Proposal 15. Section 61.39(b) has required that an applicant for an airline transport pilot certificate or an additional rating who does not wish to retake the required written examination must have been continuously employed since passing the written examination and be participating in a pilot training program. For the exception from the 24-month requirement to apply, a person had to have been employed by a carrier immediately (within 24 hours) after taking the written examination; a strike or furlough constituted a break in continuous employment, thus invalidating the exception. The FAA has determined that this rule is too restrictive, since it is possible for a pilot to be on vacation for a longer period of time than some strikes or furloughs last, and it would be unfair to apply the exception provision to the vacationing pilot but not the striking or furloughed pilot. Accordingly, Notice 80-23 proposed to amend § 61.39 to provide that the applicant need only be employed within the period ending 24 calendar months after the month in which the applicant passed the written examination and at the time of the flight test. Notice 80-23 also proposed to eliminate the continuous employment requirement and substitute a requirement to complete initial training and when appropriate, transition or upgrade training, and to meet the recurrent training requirements. Requiring an individual's training to be current is a better means of ensuring retention of the knowledge tested by the written test than requiring continuous employment.

One commenter responded in support of the proposal. The proposal is adopted as proposed.

Proposal 16. Section 61.155(d) has provided that a commercial pilot may credit toward the total flight time required for an airline transport pilot certificate any second-in-command time "in operations under Part 121." However, § 61.51(c)(3) provides that for meeting the requirements for a certificate or rating, a pilot may log as second-in-command time all flight time during which that pilot acts as second in command of an aircraft on which more than one pilot is required under the type certification of the aircraft or the regulations under which the flight is conducted. The intent of § 61.51(c)(3), when it was adopted, was that this rule should apply to the experience requirements for each kind of pilot certificate. However, at that time no change was made in § 61.155(d). Notice 80-23 proposed to eliminate the phrase "in operations under Part 121," so that all second-in-command time which meets the requirements of § 61.51(c)(3) may be credited under § 61.155. No comments were received on this proposal.

The proposal is adopted and all second-in-command time which meets the requirements of § 61.51(c)(3) may be credited under § 61.155(d).

Proposal 17. Section 63.35(d) has required continuous participation in a maintenance, flight engineer, or pilot training program of a Part 121 certificate holder for an applicant for a flight engineer certificate to be exempted from the 24-month validity period for the written examination. Similar to § 61.39, this section has been interpreted to mean that any break in employment, such as a strike or furlough, constitutes an interruption of continuous participation in a training program and prevents the exception from applying. The FAA has reevaluated this requirement and has determined that continuous participation in a training program is not essential. Currency in a certificate holder's training program for a flight crewmember or recency of experience for a mechanic employed by a certificate holder ensures knowledge retention better than continuous participation in a training program.

Notice 80-23 proposed to amend § 63.35(d) to apply the exception provision to a flight crewmember or mechanic who is employed by a certificate holder within the period ending 24 calendar months after the month in which the applicant passed the written examination, and whose training is current or meets the recent experience requirements for a mechanic under § 65.83. It also proposed to expand the rule to include employment by a commuter air carrier.

No comments were received on the proposal. It is adopted without substantive change.

Proposal 18. Notice 80-23 proposed to amend § 65.101 to allow formal training to be substituted for the practical experience now required for repairman certificate eligibility. One commenter agreed with the substance of the proposal, with the exception that completed formal training should have the prior approval of the Administrator instead of being reviewed for acceptability after completion.

Because of the diversity and uniqueness of training associated with repairman ratings, it would be impractical to establish national uniform training standards necessary for prior approval of training programs. Conversely, FAA certificated air agencies, aviation manufacturers, and air carriers are best able to establish that formal training which will qualify the repairmen they employ to perform or supervise the maintenance of aircraft or components at its facilities. The FAA can then review the training and determine if it is acceptable. This amendment will provide a logical alternative to the 18 months of practical experience formerly required for repairmen eligibility and still provide an equivalent level of competency. Accordingly, this proposal is adopted without substantive change.

Proposal 19. It was proposed to amend § 65.127(b) to provide that a parachute rigger need only have available suitable housing that is adequately heated, lighted, and ventilated for drying and airing parachutes. This section has required, in part, a compartment for hanging a parachute vertically for drying and airing. Since parachutes are now made of synthetic fabrics, a vertical or horizontal means for drying and airing parachutes is also acceptable. However, the housing must still be adequately heated, lighted, and ventilated.

No comments were received on this proposal. Section 65.127(b) is being revised as proposed.

Proposal 20. Notice 80-23 proposed to delete the list of purposes for which a special flight authorization could be issued. The intent was to eliminate the need for an applicant to petition for an exemption from previous § 91.28 when the purpose was other than that specified under the rule. This was intended to relieve the burden on both the FAA and the public imposed by exemption procedures.

Review of the comments received revealed that even though all commenters supported the proposal, they apparently misconstrued intent, in believing that CAB authority, in addition to the FAA special flight authorization, would be necessary for all purposes, including those which formerly did not require CAB authority under the previous rule. The CAB also submitted comments consistent with most commenters indicating that the proposed rule was subject to misinterpretation. The CAB provided revised language for proposed § 91.28(c) to preclude any misunderstanding as to when CAB authority would be necessary.

In this regard the FAA agrees with the commenters and the CAB that the proposal was not clear relative to when CAB authority would be necessary. Accordingly, the FAA has amended the language of proposed § 91.28 to clarify when CAB authority would be necessary.

One commenter noted that, in the case of special flight authorizations for air shows (§ 91.28(b)(6)), the application procedure contained in proposed § 91.28(a) would no longer provide for applications to be made to the Regional Director of the FAA region in which the air show will take place. The commenter stated that the existing application procedure should be retained since it is economical and effective. The FAA agrees with this comment and has amended § 91.28(a) to reinstate this application procedure.

One commenter stated that it was not clear whether the Regional Director would have authority to issue special flight authorizations for extended periods of time; i.e., once justification had been established for an initial special flight authorization, there would be no benefit in repeating the procedure for each subsequent trip, as in the case of a Canadian amateur-built aircraft to participate at United States air shows. This comment was not considered since it was determined to be outside the scope of Notice 80-23.

Accordingly, this section has been amended consistent with public comments in the interest of clarification and adopted without substantive change.

Proposal 21. This proposal would have required all helicopters operating under IFR to use altimeters which have been tested for the altitudes at which operations are conducted. Operations Review Program Notice No. 12 proposes a number of changes to § 91.170. Accordingly, this proposal is withdrawn and will be acted upon as part of that review. Comments received in response to this proposal will be given full consideration in that action.

Proposal 22. This proposal would delete references to Part 103 in § 121.135(b)(23) and insert appropriate references to Title 49 of the CFR. Since this change was previously accomplished in Operations Review Amendment No. 9 (45 FR 46736), this proposal is withdrawn.

Proposal 23. This proposal would require the interphone system to be accessible for use at enough flight attendant stations so that all floor-level emergency exist in each passenger compartment are observable from one or more of those stations so equipped. Section 121.319(a) requires, in part, that airplanes with a seating capacity of more than 19 passengers must be equipped with a crewmember interphone system. Section 121.319(b)(5)(i) requires that for large turbojet-powered airplanes, the interphone system must be accessible for use at enough flight attendant stations so that all floor-level emergency exits in each passenger compartment are observable from one or more of those stations. From a security and operational viewpoint, if the floor-level exit is located within a galley, and the entryway to the galley is observable, this will satisfy the operational/security requirements and, therefore, it would be unnecessary to view the exit itself. No comments were received on this proposal. Accordingly, it is adopted without substantive change.

Proposals 24, 25, 27, and 28. Sections 121.385, 121.389, 121.695, and 121.697 contained inconsistencies in the use of the words "aircraft" and "airplanes." The proposals would replace the word "aircraft" with the word "airplane" where it appears in §§ 121.385(a), 121.389(a)(2), 121.695(a), and 121.697(a) and (d). These editorial corrections would make the language consistent with the applicable word definitions. No comments were received on these proposals. Accordingly, they are adopted without substantive change.

Proposal 26. This proposal would have amended § 121.585 to require a certificate holder to notify a passenger declaring a firearm in checked baggage of the definition of a "loaded" firearm. It further would have required a certificate holder to determine that ammunition is carried in accordance with the Hazardous Materials Regulations in Title 49 Parts 171, 172, and 173 of the CFR.

Inasmuch as there is no evidence indicating a need for this added provision, and its implementation would impose an additional unnecessary cost on certificate holders, this proposal is withdrawn.

Proposal 29. This proposal would relieve an unnecessary burden on certificate holders that do not have clerical staffs working holidays and weekends by revising § 121.703 to change the reporting time to 9:00 a.m. the second workday following the date of the reportable event for reports covering holidays and weekends. No comments were received on this proposal. Accordingly, this proposal is adopted without substantive change.

Proposal 30. Part 129 prescribes rules governing the operation within the United States of aircraft of foreign air carriers holding a permit issued by the Civil Aeronautics Board (CAB) under Section 402 of the Federal Aviation Act of 1958. Currently, the CAB issues exemptions to permit temporary operations by foreign air carriers without a Section 402 permit provided the foreign air carrier is in compliance with Part 129. This proposal would amend § 129.1 of the FAR to make Part 129 applicable to foreign air carriers who hold either a Section 402 permit or other appropriate economic authority, or an exemption issued by the CAB which requires compliance with that Part. No comments were received on this proposal.

The phrase "conditioned upon the foreign air carrier compling with the requirements of the Part" is ambiguous since Part 129 applies regardless of CAB conditions shown on the economic authority to operate in the United States. Accordingly, this section has been amended and adopted without substantive change.

Proposals 31 and 32. These proposals were disposed of in Amendments 135-13 (46 FR 28301; May 26, 1981) and 135-15 (46 FR 30968; June 11, 1981).

Editorial Corrections

Amendments to §§ 107.13(a) and 121.575 were not proposed in Notice 80-23. They are editorial corrections which are necessary and resulted from new Part 108, Airplane Operator Security (46 FR 3782; February 15, 1981).

These amendments correct §§ 107.13 and 121.575 by inserting the appropriate reference to the new Part. No substantive change is made as a result of the corrections.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 23, 25, 45, 61, 63, 65, 91, 107, 121, and 129 of the Federal Aviation Regulations are amended effective April 28, 1982.

(Secs. 313(a), 601 through 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421 through 1425); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)); and 14 CFR 11.49)

NOTE: The FAA has determined that these amendments reduce the regulatory burden on the flying public by relaxing certain regulations that govern prerequisites for flight tests, approved parts reference for manufacturers, and special flight authorization for foreign civil aircraft by prescribing only the minimum regulations deemed necessary for safety. The FAA's evaluation of the changes to Parts 23, 25, 45, 61, 63, 65, 91, 107, 121, and 129 indicates that the benefits will exceed the costs, primarily because the complexity and volume of regulatory material have been reduced. Further, proposals contained in the notice which have potential for placing a regulatory burden on the public have been removed. Therefore: (1) it has been determined that this is not a major regulation under Executive Order 12291; and (2) I certify that, under the criteria of the Regulatory Flexibility Act, these amendments will not have a significant economic impact on a substantical number of small entities. In addition, the FAA has determined that these amendments are not significant under the Department of Transportation Regulatory Policies Procedures (44 FR 11034; February 26, 1979). The impact of this rulemaking is so minimal it does not require a final regulatory evaluation since most of the amendments are merely editorial corrections and clarifications and some have minimal relaxatory and beneficial economic impact.

Amendment 25-56

Transport Category Airplanes; Cabin Ozone Concentration

Adopted: December 3, 1982 **Effective: January 31, 1983**

(Published in 47 FR 58488, December 30,1982)

SUMMARY: These amendments relieve operators of certain airplanes from having to purchase, install, and maintain ozone control equipment or establish ozone avoidance procedures. These amendments reduce the operating cost of the affected airplanes with no reduction in flight safety.

FOR FURTHER INFORMATION CONTACT: Mr. Larry Bedore, Project Development Branch (AFO-240), Air Transportation Division, Office of Flight Operations, Associate Administrator for Aviation Standards, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591; telephone (202) 426-8096.

SUPPLEMENTARY INFORMATION:

Background

The Federal Aviation Administration (FAA) established specific airplane cabin ozone concentration standards for the issuance of type certificates for transport category airplanes. Cabin ozone standards were also adopted for the operation of large transport category airplanes by air carriers and commercial operators. The final rule was published in the *Federal Register* on January 21, 1980 (45 FR 3880), as Amendments 25-50 and 121-154.

Amendment 25-50 added a new § 25.832 which stated that the airplane cabin ozone concentration during flight above flight level (FL) 180 must be shown not to exceed 0.25 parts per million by volume, sea level equivalent, at any time and 0.1 parts per million by volume, sea level equivalent, time-weighted average during any 3-hour interval.

Amendment 121-154 added a new § 121.220 which was later changed to § 121.578 stating that after February 20, 1981, no certificate holder may operate a transport category airplane above FL 180 unless it has successfully demonstrated to the Administrator that the concentration of ozone inside the cabin will not exceed 0.25 parts per million by volume, sea level equivalent, at any time and for each flight segment that exceeds 4 hours, 0.1 parts per million by volume, sea level equivalent, time-weighted average over the flight segment.

In response to a petition for rulemaking from the Air Transport Association of America (ATA) dated April 30, 1980, which was published in the *Federal Register* on September 11, 1980 (45 FR 59905), and a petition from Rosenbalm Aviation, Inc., dated March 31, 1980, which was published in the *Federal Register* on October 9, 1980 (45 FR 67100), the FAA issued a Notice of Proposed Rulemaking (NPRM) No. 81-15 which was published in the *Federal Register* on November 23, 1981 (46 FR 57442). That notice proposed amendments to §§ 25.832 and 121.578 of the regulations to relieve operators of cargo-only airplanes and narrow-body four-engine airplanes to be retired or re-engined because of the FAA's noise regulations (14 CFR Part 91, Subpart E) from the necessity of meeting the ozone operating requirements and to simplify the compliance requirements for many other airplane operations.

Discussion of Comments

Sixteen public comments were received in response to NPRM 81-15. In summary, nine commenters agree with the NPRM; two disagree; and five comment on the overall cabin ozone concentration methodology.

The nine concurrences were from the ATA, Aerospace Industries Association of American, Inc. (AIA), Englehard Industries Division (a manufacturer of catalytic ozone destruction filters), the Human Factors Division, Wright-Patterson Air Force Base, Ohio, and five air carriers. Of the air carriers, two operate four-engine narrow-body aircraft; two operate turboprop aircraft; and one is a cargo operator.

ATA also comments that a few B-727 aircraft flights exceed 4 hours, and penalties will be associated with complying with the time-weighted average (TWA) provisions of the rule. Because of these penalties and Report No. FAA-AM-80-16, Subject: "Effects of Long-Term Exposure to Low Levels of Ozone: A Review," by C. E. Melton of the FAA Civil Aeromedical Institute dated September 1980, (which according to ATA finds the entire TWA concept to be one of questionable validity), ATA urges further relaxation of the rule to unburden narrow-body intercontinental operations from the 4-hour TWA provision. ATA also comments that the TWA should be eliminated based on Report No. FAA-AM-80-16.

The FAA did not grant that portion of the ATA petition which requested relaxation of the rules for aircraft such as the B-727 because flight segments of these narrow-body turbojet airplanes which exceed 4 hours comply with the requirements of § 121.578 without installation of ozone filters provided the airplanes do not exceed FL 390 over the continental United States (excluding Alaska). (Higher altitudes may be used in many cases as shown in Table 2 of the NPRM.) On the other hand, flights over Western North America at latitudes higher than the continental United States, almost exclusively Alaskan operations, during the months of February, March, and April could not utilize the highest possible altitude and be in compliance with § 121.578. During that 3-month period, those Alaskan operations could incur a minimal economic burden in the form of reduced fuel efficiency of less than 1 percent. For those few flights which might encounter elevated ozone levels, the public benefit of ozone avoidance outweighs the burden imposed on the operator.

Report No. FAA-AM-80-16 does not indicate that the TWA standard should be discontinued, as suggested by the commenters. The report does state, in part, that ozone concentration is more important than duration of exposure in determining the effectiveness of an ozone exposure (dose). This is interpreted to mean that peak concentrations are more important than the duration of exposure in assessing ozone-induced symptoms, and a time-weighted average may not give an accurate index of exposure without due consideration being given to peak exposures. The FAA has already taken this fact into account by having a higher standard for the maximum value than for the TWA.

In the NPRM, the FAA announced that it would allow the use of a value of 0.7 for aircraft without a measured ozone retention ratio, based on its review of recently established ratios for a number of aircraft. AIA comments that aircraft without a measured retention ratio should be allowed to use a value of 0.6 rather than 0.7 based on an average retention ratio in measured aircraft of 0.504, which it computes from Table 1 of the NPRM.

One carrier comments that Table 2 of the NPRM should be increased to show retention and altitudes for all aircraft operating above FL 250. Such an addition to the table, however, would be impractical and unnecessary.

Although the data was measured only on the aircraft types listed in Table 1 of the proposal, other aircraft types should use the data provided in Table 2 for a retention ratio of 0.7 which is an acceptable value to use if the actual ratio has not been measured.

The FAA-accepted retention ratio of 0.7 is considered reasonable. One airplane listed in Table 1 has a retention ratio of 0.59, and the B-747SP had a retention ratio of 0.83 before the air conditioning system was reconfigured. Thus, lowering the accepted retention ratio to 0.6 for use in any airplane type without a measured value would not provide for an adequate margin of error. Moreover, using this retention ratio, all but a minimal number of flights can show compliance without restricting altitude or installing ozone filters.

The Independent Union of Flight Attendants (IUFA) states that the flight crewmembers of cargo aircraft should be protected from the health hazard of ozone. The FAA recognizes that high ozone levels are a health hazard. However, as stated in the proposal, flight crewmembers of cargo-only aircraft have protection. The availability of supplemental oxygen and the sedentary activity of cargo-only aircraft occupants reduce or eliminate the physiological impact of exposure to high ozone concentrations. The safety of the aircraft and its occupants can be assured.

IUFA, the Air Line Pilots Association (ALPA), and the Association of Flight Attendants (AFA) comment that cargo-only aircraft should be excluded only if ozone monitors are required equipment on the aircraft. With respect to requiring ozone monitors on cargo-only aircraft, such action is not justified based on costs associated with equipment purchase and maintainability. Because persons aboard cargo-only aircraft are normally sedentary and have supplemental oxygen available in the event symptoms of ozone discomfort are experienced, the benefit of monitoring would be minimal.

ALPA and AFA oppose the exemption of cargo-only airplanes based on their opinion that flight planning is not acceptable and that operational avoidance is not a dependable alternative. In addition, they request that the ozone concentration limits be changed to 0.05 ppmv as an action point, 0.1 ppmv for a threshold, and 0.3 ppmv as a never-to-be-exceeded level.

Proper flight planning and in-flight procedures are recommended practices to reduce exposure by aircraft occupants to high ozone concentration. Moreover, as indicated by Table 2 of the NPRM, ozone avoidance through flight planning is only necessary in a small number of cases and for few months each year.

A tightening of the ozone concentration limits is not justified. Those limits are based on studies conducted by the FAA Civil Aeromedical Institute and are comparable to standards adopted by the Environmental Protection Agency and the Occupational Safety and Health Administration.

British Aerospace (BA) comments that the permissible maximum ozone concentration is 0.25 ppmv "at any time" as stated in the proposal while the rule uses the phrase "at any point in time." Thus, taken literally, "at any point in time" would require infinitely rapid instrumentation response. BA recommends that the rule be changed to allow the ozone concentration to exceed 0.25 ppmv for 2 minutes. BA also comments that for "altitude restrictions for flights under 4 hours," the retention ratio does not take into account the dissociation within the cabin. Accordingly, BA requests that retention ratio be defined to take into consideration the ozone concentration existing within the occupied space and not be limited to ozone which enters the airplane cabin during flight.

The meaning of the rule is not changed by dropping the words "point in." Ozone monitoring equipment is not required. Thus, this provision should not raise the problem addressed by the commenter because no requirement exists for onboard ozone monitors. Compliance with these rules may be shown by statistical means. In addition, measured retention ratios accepted by the FAA use an airplane cabin average value, not the ozone as it enters the airplane. Thus, it is unnecessary to define retention ratio as the commenter suggests.

Economic Evaluation

These amendments clarify and modify Cabin Ozone Contamination Rules. These amendments specifically relieve two types of operators, those that operate cargo-only aircraft and those that operate certain narrow-body four-engine aircraft. Operators would not have to install ozone filters in these aircraft. So the rule will initially save up to $1.4 million for the cargo-only operators and $7500,000 for the narrow-body four-engine aircraft, for a total saving of $2,150,000. Recurring costs saved are about one-third of that, or $700,000 annually. These benefits are savings for not having to comply with the regulations as they were before these amendments. There are no costs to society or air carriers for adopting these amendments.

Adoption of the Amendment

Accordingly, the regulations (14 CFR Parts 25 and 121) are amended, effective January 31, 1983.

(Secs. 313, 601, 603, and 604, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354, 1421, 1423, and 1424); sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c).)

NOTE: These amendments relieve certain operators of large transport category aircraft of the economic burden of purchasing, installing, and maintaining ozone control equipment on some airlines or establishing ozone avoidance procedures. Accordingly, the FAA has determined that this document involves a final rule which is not major under Executive Order 12291 or significant under DOT Regulatory Policies and Procedures (14 CFR 10034; February 26, 1979). For this same reason and because the operating rule changed by this amendment does not, for the most part, apply to operations by small entities, and the change in the certification rule will have only a minimal effect on the price of certain transport category aircraft that might be purchased by small entities, it is certified that under the criteria of the Regulatory Flexibility Act, this final rule will not have a significant economic impact on a substantial number of small entities. A copy of the regulatory evaluation for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Amendment 25-57

Aircraft Engine Regulatory Review Program; Aircraft Engine and Related Powerplant Installation Amendments

Adopted: December 16, 1983 **Effective: March 26, 1984**

(Published in 49 FR 6832, February 23, 1984)

SUMMARY: This amendment updates the airworthiness standards applicable to the type certification of aircraft engines and of aircraft with respect to engine installations. The changes implement the President's Regulatory Reform Program by simplifying a number of technical requirements, by eliminating unnecessary rules where appropriate, and by removing administrative burdens on regulated persons and the FAA through amendment of regulations from which exemptions have been granted. The regulations update and modernize technical requirements to reflect engineering advances in the state-of-the-art and take into account accumulated service experience and recommendations of the National Transportation Safety Board (NTSB).

FOR FURTHER INFORMATION CONTACT: George F. Mulcahy, Engine and Propeller Standards Staff, ANE-110, Aircraft Certification Division, New England Region, Federal Aviation Administration, 12 New England Executive Park, Burlington, Massachusetts 01803; telephone: (617) 273-7330.

SUPPLEMENTARY INFORMATION:

BACKGROUND

Following recodification in 1965, the first significant revision to the Code of Federal Regulations (CFR) Title 14, Part 33—Airworthiness Standards: Aircraft Engines, was made late in 1974 by Amendment 33-6. The amendment sought to accommodate the increasing complexity of airframes and engines and their interfaces and the further impact of supersonic flight. During ensuing years, as the industry became even more complex and specialized, the need for clarification and elimination of redundancies in test and design requirements became evident.

Responding to these needs, the FAA in mid-1977 announced an Aircraft Engine Regulatory Review Program, solicited rule change proposals from the aviation and general community, and held a week-long Regulatory Review Conference in January 1978, attended by over 100 industry and public representatives.

Based on information received during the review program and conference, the Administrator issued Notice of Proposed Rulemaking (NPRM) 80-21, Aircraft Engine Regulatory Review Program; Aircraft Engine and Related Powerplant Installation Proposals (45 FR 76872; November 20, 1980), which proposed to upgrade the airworthiness standards applicable to the type certification of aircraft engines and of aircraft with respect to engine installations. Comments on the proposals were invited until February 18, 1981.

Interested persons now have been given an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented. The proposals and comments are discussed below. Substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those proposed and explained in Notice 80-21.

DISCUSSION OF COMMENTS

The following discussion summarizes the comments received from the public, from industry, and from foreign authorities. Proposals are numbered as in Notice 80-21.

Proposal 1. This amendment clarifies § 23.901(d), which calls for a determination that installation effects do not cause any deterioration of powerplant rain ingestion tolerance as demonstrated by the engine in compliance with the engine certification standards of § 33.77.

One commenter advises that it is not clear whether a specific determination for deterioration of powerplant rain ingestion tolerance is required for the intake-engine combination or whether the test of Part 33 would suffice. The intent of the proposed rule is to ensure that installation effects do not result in any deterioration of powerplant rain ingestion tolerance. This requires a separate determination for the engine installation, other than that required by 14 CFR Part 33.

A commenter recommends that flight idle be included in the evaluation of operation in rainfall conditions. The FAA agrees that the regulation, as proposed, does not specify operating conditions for the rain ingestion investigation and the operating conditions of takeoff and flight idle are added to the rule as adopted.

One commenter recommends that the specified liquid water content be compared to engine induction airflow rate. It is the intent of the regulation to proportion the ingested liquid water content in relation to the induction airflow, and this recommendation would afford clarification. Therefore, the proposed rule is revised by adding the phrase "4 percent of engine airflow by weight."

A commenter recommends that the requirement for 3 minutes of operation at flight idle in rain be deleted. The FAA disagrees. Satisfactory operation of an engine for 3 minutes at flight idle in the rain conditions specified will provide assurance that it will satisfactorily operate throughout the rain conditions likely to occur in service. The 3-minute time period is therefore retained.

A commenter recommends that the regulations be clarified by removal of words such as "safe" and "hazardous," which are considered ambiguous. The FAA believes that these words have a common interpretation in aviation and that § 23.901 is sufficiently clear without further change.

Proposal 2. This amendment to § 23.903(a) permits the installation of an engine approved under standards other than those of 14 CFR Part 33, such as Part 13 of the Civil Air Regulations (CAR) or Part 21 of the Federal Aviation Regulations (FAR). In addition, provision is made for approving installation of a type certificated engine on the basis of satisfactory service experience if the engine has not specifically complied with § 33.77. Proposed § 23.903(b) also will require that precautions be taken in the design of aircraft to protect vital components from the effects of uncontained rotor failures and engine fires.

Four commenters request that § 23.903(a) be revised to include reference to § 21.29(a) (1) (ii), which pertains to certification of import products. To be eligible for installation in a U.S. type certificated aircraft, an engine must have a U.S. type certificate. Engines imported from a foreign country type certificated in accordance with § 21.29 are covered by the amended wording of § 23.903(a), and no further action is required.

One commenter advises that under the proposed wording of § 23.903(a) (2) (i) existing engines could be disqualified each time § 33.77 was amended, a condition which would be unreasonable. The intent of this rule change is to ensure an acceptable level of safety for all engine installations with relation to foreign object ingestion (FOI). A certificated engine which has shown compliance with an approved standard and has had a satisfactory FOI service history when installed in a similar aircraft location will continue to be eligible for installation in an aircraft under paragraph (a) (2) (ii). Therefore, no further change to the proposed rule is necessary.

A commenter advises that the proposed wording of § 23.903(a) (2) (ii) would deny an applicant the right to apply service experience from a particular aircraft engine installation to justify certification at a different location on the aircraft. The commenter states that there is no proof that some installation locations have a higher frequency of ingestion than others, wing mounted versus aft mounted, for example, nor has frequency of ingestion been found to be related to engine capability to withstand ingestion of objects. FAA policy is to certify engines independently of installation location and/or number of engines per aircraft. Nevertheless, when satisfactory service experience is used as a basis of approval of an engine installation, the location of the engine during the time this experience was accumulated must be considered to determine whether the new installation is more or less subject to FOI, and whether similar results may be expected in the proposed installation. This policy is adequately expressed in the proposal, and no further change is necessary.

One commenter recommends clarifying § 23.903(a) with a third qualifying condition: that the engine be shown to comply with § 33.77 in effect at the time of engine type certification. The FAA has determined that addition of a third alternative might result in an unacceptable level of safety under FOI conditions. Section 33.77 in effect October 1, 1974, or thereafter is specifically referenced to preclude this eventuality.

A commenter recommends that § 23.903(b) be revised to specify the areas needing protection from rotor burst, such as fuel systems, flight control systems, and occupied areas of the fuselage. The FAA notes that areas which may be critical in one aircraft with respect to the effects of rotor burst may not be critical in another. Accordingly, it is left to the designer to determine which areas must be protected and how to protect them, and the proposed general language provides such latitude. However, the FAA will evaluate such design for compatibility with the intent of this regulation.

One commenter objects to the wording of the proposed regulation and does not consider turbine engine rotor failure or casing burn-through a problem for small aircraft engines. Turbine engine rotor failure has been reported in small turbine engines, although problems have not been noted in recent years. As long as the potential for failure continues to exist, however, the problem should remain under consideration. Measures taken to protect aircraft from effects of rotor burst also are expected to resist burn-through. Proposed § 23.903(b) as drafted ensures protection appropriate to the risk involved and is therefore adopted as proposed.

Proposal 3. This amendment revises existing § 23.905 to allow installation of a propeller approved under standards other than 14 CFR Part 35. Commenters agree with this rule change. Therefore, except for deletion of the qualifier "approved," which is not applicable in reference to a type certificate, the rule is adopted as proposed.

Proposal 4. This amendment to § 23.975(b) requires that each fuel injection engine employing vapor return provisions, as well as carburetor engines having such provisions, have a separate vent line to return vapor to the vapor space in one of the fuel tanks. Four commenters recommend that the proposed regulation be revised to require fuel vapor to be returned to the fuel tank but not specifically to the vapor space, provided the return line location is carefully selected. However, carburetors with vapor elimination features currently in service have a very low return fuel pressure with which to overcome flow resistance in the line, so that the static fuel pressure head at a particular location might be sufficient to prevent proper venting of the carburetor. Also, discharging the vapor return line into the fuel tank at a location near the fuel tank outlet could result in vapors being reintroduced to the engine with subsequent loss of power. The proposed amendment is changed in accordance with these comments to specify that the vapor be returned to the top of one of the fuel tanks.

One commenter recommends that it would be preferable to return the vapor to the selected tank (the tank being used). The FAA agrees but considers this requirement to be a substantial change which would add significant complexity and cost to the fuel system of airplanes certificated under Part 23 without a commensurate increase in safety.

Proposal 5. This amendment to § 23.994 redefines the required protection against fuel spillage in terms of that occurring after wheels-up landing on a paved runway. One commenter questions whether any amount of fuel spillage should be allowed during a wheels-up landing. Another suggests that a specified amount of spillage would be more appropriate. The FAA agrees that it would be desirable to prevent any fuel spillage during a wheels-up landing on any type of landing surface, but it also recognizes that release of minute quantities of fuel would not be likely to present a fire hazard and that complete avoidance of fuel spillage or approval of a specific amount would be very difficult. Therefore, the regulation is adopted as proposed.

Proposal 6. This amendment adds a new § 23.995(g) specifying that fuel tank selector valves must take a separate and distinct action to place the selector in the "OFF" position and that the selector must not pass through the "OFF" position when changing from one tank to another.

One commenter recommends that the proposed wording be changed to read "The valve shall be designed so that it is not necessary to move the selector through 'OFF' position when switching tanks." The FAA believes that the proposed phrasing is more positive, and the rule is adopted in this form. This change is in accordance with National Transportation Safety Board (NTSB) Safety Recommendation No. A-79-72.

Proposal 7. Part of the proposed amendment to § 23.997 was intended to make it clear that an aircraft manufacturer need not duplicate equipment or tests of fuel strainers or filters if they were provided and approved as part of a certificated engine and if they also meet the requirements of this subpart. The proposed wording, however, inadvertently exempted such provided equipment from the latter requirement. The intended relief is already provided as an option to aircraft and engine manufacturers under the current rule. Therefore, the portion of the proposed rule exempting engine-supplied devices is withdrawn.

The rule also corrects terminology and relieves design requirements for mounting fuel strainers or filters.

Commenters question the meaning of the words "fuel metering device," recommend that filtration standards be included for the filters/strainers, and recommend that the fuel filter be placed ahead of any other fuel system component subject to contamination. The FAA has determined that a fuel metering device is commonly understood to be one which regulates or "meters" fuel flow and that fuel filtration standards should not be included in the regulation but covered by policy material. The rule, in conjunction with § 23.977, assures that filters and strainers are properly located to prevent contaminants from blocking components other than pumps and controls. In some installations the suggested locations would in fact be unfeasible.

Proposals 8 and 9. The proposed changes to §§ 23.1013 and 23.1015, which deal with oil tanks approved and provided as part of an engine, are withdrawn for the same reasons given in Proposal 7 for withdrawing the portion of the wording exempting engine-supplied devices.

Also, a commenter questions whether an equivalent provision originally proposed for Part 25 applies to engines certificated to the standards of Part 33 before Amendment 33-6 and suggests that this be clarified. The commenter asserts that the oil tanks may be unsafe if not substantiated under Amendment 33-6. The concern expressed by the commenter has been taken into account by withdrawing the proposal.

Proposal 10. This change to § 23.1019 corrects terminology and is intended to relieve the airplane manufacturer from duplicating compliance with oil strainer/filter design requirements if they are provided and approved as part of the engine to be installed. The proposed rule, except for that portion which corrects terminology, is withdrawn for the reasons given in Proposal 7.

One commenter recommends that oil filtration standards be included in the regulations. The FAA believes that filtration standards would be more appropriately covered by an advisory circular or equivalent advisory information.

Proposal 11. This proposal amends § 23.1021 to permit the use of multiple oil system drains, if necessary, to provide more efficient drainage. All commenters agree with the change, and the regulation is adopted as proposed.

Proposal 12. The proposed change of § 23.1093 brings the ground idle induction system icing test conditions into conformance with Appendix C of 14 CFR Part 25 and permits periodic operation at increased power or thrust higher than ground idle as an ice protection measure.

One commenter questions whether "momentary operation at takeoff power" is adequate. Another commenter questions whether allowing engine runup on an icy taxiway would be a safe condition. The FAA agrees that the second comment may have merit under certain conditions. However, the relaxatory nature of this part of the regulation need not be denied applications where safety is not compromised. On icy runways, the decision to use momentary power or thrust to remove induction ice would remain with the flightcrew. The first comment addresses part of the current regulation not raised under Notice 80-21 and therefore is outside the scope of the proposed change.

One commenter recommends a referenced military specification, MIL-E-5007D, which would be a somewhat more severe requirement (25°F, mean effective drop diameter 30 microns, and .4 grams per cubic meter liquid water content). Actual meteorological data, as presented at the Aircraft Engine Regulatory Review Conference, does not support this severe a requirement. It is considered that the revised test criteria take into consideration actual ground icing conditions, including an adequate margin of safety, and that compliance with MIL-E-5007D is not warranted. Therefore, § 23.1093 is adopted as proposed.

Proposal 13. This proposed change would add a new § 23.1143(e) to: (1) state engine control requirements not only for antidetonant injection (ADI) systems, but for other fluid injection systems (other than fuel) as well; (2) make it clear that any fluid injection system and its controls provided and approved as part of the engine need not be duplicated by the aircraft manufacturer; and (3) specify a separate control for fluid injection pumps.

Five commenters object to proposed § 23.1143(e)(1) on the grounds that it restricts design of fluid control to one of a number of satisfactory types. It is their view that fluid injection requirements are influenced by other factors which may not relate to the amount of power produced by an engine in service. In some cases, the engine installations have fluid systems that do not vary the fluid flow with power. Fluid is injected in a fixed amount, and power is varied by the engine fuel control via the power lever. The proposed paragraph is rephrased to permit more flexibility in design.

One commenter requests that the regulations be clarified so that separate control for fluid injection pumps is required regardless of whether or not the injection system is approved as part of the engine. Another suggests deletion of this paragraph as some current systems do not use pumps. The FAA agrees with the commenters, and the proposed regulation is revised accordingly.

The portion of the proposed rule exempting engine-supplied devices from the requirements of this section is withdrawn for the reason given for § 23.997.

Proposal 14. This amendment revises § 23.1163(a) to make it clear that it is the ultimate responsibility of the aircraft manufacturer who installs an engine to assure proper sealing of engine oil lubricated accessories.

Three commenters request clarification of paragraph (a)(3) to define what is to be sealed. The FAA concurs that the intent is unclear and proposed paragraph (a)(3) is changed to define the extent of sealing.

Proposal 15. The amendment to § 23.1183 would raise the limiting capacity of reciprocating engine oil sumps from 20 to 25 quarts before fireproofing or shielding is required. Also, the regulation exempts components, as well as lines and fittings that have been approved as part of the engine, from these requirements. These changes remove unjustified engine design limitations and afford increased range capabilities.

One commenter recommends that the 20-quart capacity limit required by paragraph (a) be retained. The proposal is seen as an arbitrary accommodation of a particular application for type certification, but the commenter does not supply specific information or data to support this claim. A search of FAA records has not disclosed such an application.

Neither service with 20-quart capacity oil systems nor any other evidence has shown that there would be any compromise of safety associated with a sump capacity of 25 quarts of oil as opposed to 20 quarts in the case of a powerplant fire. The amendment is adopted as proposed.

Proposal 16. This amendment to § 23.1189(a) (1) and (b) (2) clarify the requirements for shutoff means for flammable fluids in multiengine aircraft and for turbine engine oil systems.

One commenter recommends that this rule be cross-referenced to 14 CFR Part 33. Another commenter suggests addition of the word "installation" to paragraph (a) (1) for the sake of clarity.

The FAA does not consider a cross reference to Part 33 necessary since the emphasis of this section is upon the aircraft manufacturers' responsibility to ensure a fireproof engine installation. Adding the word "installation," however, will provide additional clarification. The proposed regulation is adopted with this change.

Other comments contain proposals for Part 23 which were not on the agenda of the Aircraft Engine Regulatory Review Program. These include the addition of a new § 23.907 concerning acceptable propeller stress levels and addition of a rule requiring that positive pressure be maintained within fuel tanks to prevent vapor formation. These recommendations are outside the scope of the proposed amendment and are not addressed by this rulemaking.

Proposal 17. This revision of § 25.33(a) (2) corrects and updates an obsolete reference to the rules and does not constitute a substantive change. No unfavorable comments were received, and the proposal is adopted.

Proposal 18. No unfavorable comments were received with respect to revising § 25.697(a) to correct reference to obsolete rules. The proposal is therefore adopted without change.

Proposal 19. For a discussion of comments on the proposed amendment to § 25.903(a), see the proposal for § 23.903(a).

Proposal 20. This proposal revises § 25.905(a) to allow installation of a propeller type certificated under the procedures of CAR Part 14 or § 21.29 of the FAR, as well as Part 35 of the FAR. No unfavorable comments were received with respect to revising § 25.905(a). Therefore, except for deletion of the qualifier "approved," which is not applicable in reference to a type certificate, the rule is adopted as proposed.

Proposal 21. Six commenters object to and recommend deleting the proposed change to § 25.939(b). The consensus is that determination of surge and stall margins in quantitative terms is beyond the current state-of-the-art and that adequate investigation of engine stall, surge, and flameout characteristics is currently covered by the requirements of § 25.939(a). Therefore, the proposed change to § 25.939(b) is withdrawn. The comparable proposal to amend § 33.65 also is withdrawn.

Proposal 22. This amendment to § 25.961 restores test conditions for hot weather fuel system operation previously deleted.

One commenter recommends deleting proposed paragraph (a) (4) (i) (D), arguing that the center of gravity is not relevant to hot fuel tests. This reference to the most unfavorable center of gravity was continued over from the deleted § 25.65(a) (4) as one of the conditions for demonstrating all engine climb in cruising configuration. The FAA agrees that unfavorable center of gravity is not relevant to the hot fuel test, and paragraph (a) (4) (i) (D) of the proposed change is deleted. The proposed amendment is adopted as revised.

Proposal 23. For a discussion of comments on and disposition of the proposed amendment to § 25.994, see the proposal for § 23.994.

Proposal 24. For a discussion of comments on and disposition of the proposed amendment to § 25.997, see the proposal for § 23.997.

Proposal 25. The proposed revision of § 25.1001 removes the distinction between fuel jettisoning systems for reciprocating and turbine engine-powered airplanes, deletes obsolete sections, and corrects references to climb performance sections. Other changes are editorial in nature, eliminate redundancies, and clarify the text.

No unfavorable comments on the proposed change of § 25.1001 were received. However, two commenters recommend rephrasing the requirement of paragraph (d) (3) to specify that fuel or fumes do not enter any part of the airplane in sufficient quantity to constitute a fire or explosion hazard, maintaining that not all fuel or fumes necessarily constitute a fire or explosion hazard. A third commenter recommends revising paragraph (b) to rectify a condition in which the intended reduction in airplane weight cannot be achieved when jettisoning is initiated with the fuel quantity and distribution associated with takeoff at maximum zero fuel weight (that is, for short range with high cabin load).

Fuel or fumes should not be allowed to reenter any part of the airplane during an emergency condition such as jettisoning. It would be difficult to establish the amount of fuel or fumes that does constitute a hazard. Regarding the wording in paragraph (b), the FAA agrees that the comment has merit; however, it is outside the scope of the proposed change. The rule is adopted as proposed.

Proposals 26 and 27. No unfavorable comments were received in response to the proposed changes to §§ 25.1013 and 25.1015. However, the portion of the proposals dealing with oil tanks provided and approved as part of an engine is withdrawn for the reasons stated for § 23.997. For a discussion of reciprocating engine oil sump capacity in relation to fireproofing requirements in § 25.1013, see the proposal for § 23.1183.

Proposal 28. No adverse comments were received on the proposal to amend § 25.1019, and the change is adopted as proposed. For a discussion of this change, see the proposal for § 23.1019.

Proposal 29. No adverse comments were received on the proposal for § 25.1021, and it is adopted as proposed (See the proposal for § 23.1021).

Proposal 30. This amendment to § 25.1045(d) corrects references to performance requirements which have become obsolete. In addition, a commenter would delete the cooling test configuration center of gravity requirement as irrelevant. Another commenter suggests the following rewording: ". . . the most unfavorable center of gravity position at which the airplane can be flown safely."

Reference to the most unfavorable center of gravity was carried over from deleted § 25.67, which governed demonstration of one engine inoperative climb. Section 23.121(c) is the new reference, and it has no requirement for center of gravity position. In any case, the airplane must be flown within the airplane limitations.

The FAA agrees that for this cooling test the effect of center of gravity position is negligible and does not affect the outcome. The proposed amendment is revised and adopted.

Proposal 31. This amendment to § 25.1091(e) requires the foreign object ingestion criteria of § 33.77 to be applied to vulnerable portions of induction systems.

Comments received were generally favorable. Two commenters recommend, however, that additional wording be included to specify the air induction system parts or components to be considered under this rule.

The FAA believes that the proposed change adequately states the performance objectives of the airplane air induction system and the criteria to be applied. Listing specific components to be protected would ignore possible future developments. The change to § 25.1091(a) therefore is adopted as proposed.

Proposal 32. For a discussion of comments on and disposition of the proposed amendment to § 25.1093(b) (2), see the proposal for § 23.1093(b) (2).

Proposal 33. For a discussion of comments and disposition of the proposed amendment to § 25.1143(d), see the proposal for § 23.1143(e).

Proposal 34. For a discussion of comments on and disposition of the proposed amendment to § 25.1163(a), see the proposal for § 23.1163(a).

Proposal 35. For a discussion of comments on and disposition of the proposed amendment to § 25.1183(b) (1), see the proposal for § 23.1183(b) (1).

Proposal 36. For a discussion of comments on and disposition of the proposed amendments to § 25.1189(a) (1) and (2), see the proposals for § 23.1189(a) (1) and (b) (2).

Proposal 37. This amendment would have deleted § 25.1305(d) (3), which calls for a rotor system unbalance indicator in each turbojet installation.

One commenter disagrees, stating that the requirement should be retained and arguing that foregoing the monitoring of airborne vibration would be a retrograde step. The commenter claims that well developed systems have shown more than adequate reliability and are considered capable of giving advance warning of impending failures.

Service experience has not shown that installation and use of airborne vibration monitor (AVM) systems are universally beneficial, as they are not totally effective in providing advance warning of all hazardous engine failure modes. However, recent experience, since this amendment was proposed, has demonstrated the potential of an AVM to provide a safety improvement as discussed by the first commenter. Therefore, the proposal to delete § 25.1305(d) (3) is withdrawn pending further study.

Proposal 38. No unfavorable comments were received regarding the proposed change to § 25.1323(b) (2), which deletes an obsolete reference to § 25.59, and it is adopted without change.

Nonsubstantive changes are made to §§ 25.1359 and 25.1521 which were not included in the Regulatory Review Conference Agenda or in Notice 80-21. These amendments correct typographical errors and references.

Proposals 2 and 19 modify §§ 23.903(a) and 25.903(a), respectively, to require an "approved type certificate" for each engine installed, rather than a type certificate issued under Part 33 only. The discussion presented for the proposal for § 23.903(a) also applies to §§ 27.903(a) and 29.903(a). Therefore, substantively identical changes to these actions are adopted.

A commenter suggests that in connection with the revised wording, turbine engines installed in rotorcraft should be required to comply with the foreign object ingestion requirements of § 33.77, which is now the case for engines type certificated after October 1, 1974. For engines for which application for type certificate was made before that date, this suggestion constitutes a substantive change beyond the scope of this rulemaking and is not adopted.

Proposal 39. For a discussion and disposition of the proposed amendment to § 27.997, see also the proposal for § 23.997.

One commenter questions the rationale behind deleting the phrase "and the mesh" and claims that without this phrase only filter capacity is addressed by the rule. The term "mesh" is not applicable to filters or filter elements. However, fuel filtration requirements, including mesh, particle size, and density, if not satisfied by the engine manufacturer, will be prescribed in the instruction manual for installing and operating the engine (§ 33.5). Therefore, in this case, compliance would be assured by reference to § 33.5 in § 27.901(c) (1) and the requirements in § 27.977 (§§ 29.901(b) (1) (i) and 29.977 for Part 29).

Proposals 40, 41, 42 and 43. For discussion and disposition of the proposed amendments to §§ 27.1013, 27.1015, 27.1019, and 27.1021, see the proposals for §§ 23.997, 23.1019, and 23.1021.

Proposals 44 and 54. These proposals would delete §§ 27.1093(b) (2) and 29.1093(b) (2), which are the current requirements for demonstrating satisfactory powerplant operation when exposed to atmospheric icing during ground operating conditions. The basis for deletion is the contention that engine induction system icing during ground idle operation has not been a significant problem with rotorcraft, assuming they are not required to queue up for takeoff as are airplanes. Subsequent FAA review of rotorcraft utilization discloses that extended ground operation of rotorcraft during icing conditions, although infrequent, must be expected. The proposals to delete §§ 27.1093(b) (2) and 29.1093(b) (2) therefore are withdrawn and the sections are reworded as in §§ 23.1093(b) (2) and 25.1093(b) (2).

For further discussions on this amendment, see Proposal 75 for § 33.68 and Proposal 12 for § 23.1093.

Proposals 45 and 55. These amendments add new §§ 27.1143(d) and 29.1143(d) and (e) specifying that fluid injection (other than fuel) controls be in the throttle controls and eliminating duplicate certification requirements, as in §§ 23.1143 and 25.1143. However, the term "throttles" is a misnomer for modern turbine engines installed in rotorcraft. Changes needed to rectify the terminology would be beyond the scope of this review. The proposals to amend §§ 27.1143 and 29.1143 are withdrawn and will be referred to the Rotorcraft Regulatory Review Program for consideration.

Proposals 46 and 56. For a discussion and disposition of the proposed amendments to §§ 27.1163(a) and 29.1163(a), see the proposal for § 23.1163(a).

Proposals 47 and 57. These amendments to §§ 27.1183 and 29.1183 establish a new capacity limit of 25 quarts instead of 20 quarts for reciprocating engine integral oil sumps before requiring the sumps to be fireproof or have fireproof shielding. For a discussion of comments on and disposition of the proposals, see the proposal for § 23.1183.

Proposals 48 and 58. For a discussion and disposition of the proposed amendments to §§ 27.1189 and 29.1189, see the proposal for § 23.1189.

Proposals 49, 50, 51, 52, and 53. For discussion and disposition of the proposed amendments to §§ 29.997, 29.1013, 29.1015, 29.1019, and 29.1021, see the corresponding proposals for Part 23.

Proposal 59. This amendment to § 33.7 revises the engine operating limit requirements for fuel and oil temperature and pressure, overhaul, and windmilling r.p.m.

All comments support adoption of this proposal. Additionally, two commenters propose changing Appendix A of Part 33 to be compatible with deleting the word "overhaul," as proposed in the amendments to §§ 33.7(c)(17) and 33.90. However, reference to the term "overhaul" is still appropriate to many turbine and basically all reciprocating engines. While the FAA believes there is merit in considering a restructuring of Appendix A, it goes beyond the scope of the Notice 80-21. Accordingly, the amendment is adopted as proposed.

Proposal 60. This amendment to § 33.14 revises and clarifies the rules establishing engine low-cycle fatigue limits.

One commenter suggests that the definition of start-stop cycle fails to account for reduced power takeoff and therefore should be modified to read ". . . accelerating to takeoff thrust levels . . ." rather than ". . . accelerating to maximum rated power or thrust. . . ." Reduced power takeoff is an operational procedure determined by prevailing factors such as aircraft weight, runway length, and density altitude. The FAA believes the fatigue life used for certification should be the minimum service life based on maximum ratings since the engine operational characteristics will vary for each aircraft installation. Both cyclic and hourly life credits for reduced stress levels experienced by some discs during reduced power takeoff can be adjusted by the use of approved methodology. One engine manufacturer has done so by creating "disc life factors" to apply to those cycles or hours of operation under required conditions. The established life thus has a certain conservative bias, as it is based on maximum ratings.

Another commenter objects to the proposed wording of this section because it eliminates the distinction between maximum predicted and initial service life and suggests that a part could continue in service up to its maximum predicted life without undergoing the specified sampling program. The commenter suggests that some fixed percentage of the predicted life be established as the initial service life. The FAA does not agree that a lack of distinction will exist between initial and predicted life. The predicted life of a disc is evaluated by the applicant using approved low-cycle fatigue methodology involving factors such as material properties, engine thermodynamics, etc., which when used in the analysis result in a confidence level for the predicted life. Based on this confidence level, the service life may vary from one-third to three-fourths or more of the predicted life. To require the initial service life to be a fixed proportion of the predicted life, i.e., 50 percent for instance,

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would place an undue burden on the applicant with no commensurate safety benefit. Any program to increase the initial service life must include sampling or inspection procedures. For these reasons, the rule, except for some editorial changes, is adopted as proposed.

Proposal 61. No unfavorable comment was received on the proposal to amend § 33.15(b) by deleting the phrase "or Technical Standard Orders," given erroneously as a standard for engine materials, and the proposal is adopted without change.

Proposal 62. This amendment to § 33.17 increases the limiting oil capacity for reciprocating engine integral oil sumps from 20 to 25 quarts before fireproofing is required.

One commenter takes exception to the wording of § 33.17(a), which implies that any structural failure or overheating in turbine engines would represent a hazardous condition. The same language has been carried under deleted § 33.17(f) and has presented no problems in interpretation.

A commenter recommends that the present 20-quart oil limit be retained, implying that it was established by fire testing. The FAA has no records which show that the 20-quart limit was derived from fire test data. Its original intent was to exclude the integral oil tanks of small reciprocating engines from fireproofing requirements, and it was based on years of satisfactory service experience. The FAA does not believe that raising this limit to 25 quarts as proposed will violate the original intent (see also the proposal for § 23.1183). Since the 25-quart limit was proposed over 4 years ago, the FAA has received no evidence that would indicate this change would compromise safety. Therefore, the amendment is adopted as proposed.

Proposal 63. This amendment to § 33.19(a) requires an applicant for an engine type certificate to define the trajectories of rotor blade fragments exiting outside compressor or turbine rotor cases.

Two commenters object to the last word of § 33.19(a) in that it is unduly restrictive. The commenters state that the requirement that fragment energy levels and trajectories be "defined" can be interpreted to mean precisely defined by tests, whereas in practice they may be determined by engine tests, component tests, and/or analysis. The FAA disagrees that use of the word "defined" is unduly restrictive. It is the FAA's intent that the boundary condition for possible fragments be set and therefore defined. The method used may include engine tests or other means acceptable to the Administrator.

Another commenter suggests that a corresponding change be made to § 33.5 to provide for the location of the data on fragment energy levels and trajectories. However, a change to § 33.5 is not required since the actual location of this data will be referenced on the engine data sheet.

Another commenter suggests a clarification of the rule is required to specify that only where fragments leave the engine through the inlet or turbine exhaust should the energy and trajectories be defined. The FAA believes this clarification is unnecessary. The first portion of the current rule requires containment of damage from blade failures. The new sentence would require definition of the boundary conditions for debris generated by the blade failure and ejected by the engine. It is this possible secondary damage due to debris exiting the inlet, fan, or core exhaust that is pertinent. Accordingly, the proposal is adopted without change.

Proposal 64. This revision of § 33.23 refines definitions and load limits for engine mounting attachments and structure.

Several commenters suggest changing § 33.23(b) to make the wording similar to the aircraft primary structural requirements of §§ 23.305(a) and (b) and 25.305(a) and (b). It is suggested that "permanent deformation in § 33.23(b)(1) be changed to "detrimental permanent deformation." This change would recognize the slight deformations associated with structural hysteresis which do not adversely affect the structure.

It is further suggested that any deformation at limit load which interferes with engine operation should not be permitted, although § 33.23 does not so state, and that the § 25.305, 3-second criterion for demonstration of ultimate load is also appropriate for

§ 33.23(b)(2); otherwise, the rule could be interpreted to require the structure to withstand ultimate load for an indefinite period of time.

The FAA believes that the primary structural requirements of § 25.305 are appropriate where a variety of designs serving the many structural needs of an aircraft must be evaluated under a single rule. Engine mounting attachment structure represents a much narrower range of design for which the additional provisions of § 25.305 are not needed. Current practice and service experience support this opinion. Therefore, the wording "permanent deformation" is retained.

One commenter would also specify that the engine mounting attachments and structure withstand repeated application of normal loads; that is, there should be fatigue substantiation of critical structural components. Although not currently required, engine mounting attachments and structures are in fact being confirmed under repetitive loading. Adopting this requirement would, however, add regulatory demands beyond those of the proposal. The question of requiring substantiation of mounting attachments and structures under cyclic loads will be considered for future rulemaking action.

One commenter suggests inserting the word "engine" in § 33.23(a) and (b) to modify "structure" and thus avoid implying that aircraft structure is meant. The FAA agrees, and the proposal is adopted with the wording changed accordingly.

Proposal 65. No unfavorable comment was received on the proposal to amend § 33.25 to delete an unnecessary sentence relating to load requirements already specified in § 33.49(a) and § 33.87(a)(6) for reciprocating and turbine engines, respectively. The amendment permits a minute amount of oil leakage from the engine interior and assigns ultimate responsibility for engine/accessory drive sealing to the aircraft manufacturer. Accordingly, the amendment is adopted as proposed.

Proposal 66. This amendment to § 33.27 revises overspeed test conditions and strength requirements for turbine, compressor, and turbosupercharger rotors and extends these criteria to fan rotors.

Two commenters object to the proposed wording of the posttest acceptability criteria in the last sentence, stating that it is unnecessarily loose and subject to varied interpretation. The FAA disagrees. The intent of the test is to ensure that compressor and turbine rotors have sufficient structural strength to provide reliability and safety during an inservice overspeed situation. The acceptability criterion is that parts show no evidence of incipient failure or distortion which could cause hazards. Such evidence will differ for each engine type design, and a determination must be made for each case. Although the wording of the current rule is revised, it continues to state that for each type design a proven acceptable condition must be met and demonstrated.

Two commenters recommend that § 33.27(c)(2)(v) and (vi) need not apply if the failure events described are considered improbable. The FAA disagrees. Service experience shows that most severe engine failures, including those caused by disc and shaft failures, would have been judged improbable beforehand. Attempts to apply probability to this rule would not be in the interest of airworthiness.

Two commenters request that maximum permissible r.p.m. be defined as the highest steady state r.p.m. at which an engine shaft can rotate in service. The FAA disagrees. If an engine has a transient rotor speed limitation higher than the steady state limitation, maximum permissible r.p.m. would be the maximum transient speed limit.

Another commenter suggests rearranging § 33.27(c)(2) for clarification and allowing rotor discs with sections thinner than type design to be used to produce equivalent stresses at lower r.p.m. The FAA does not believe that the proposed rearrangement of paragraph (c)(2) would significantly clarify the requirements of the section. While the use of thinned rotor discs as test articles may be justified under certain circumstances, the practice should not be considered typical or normal. The conditions under which this expedient might be acceptable must be evaluated on an individual basis and a determination of equivalency made. Accordingly, the amendment is adopted as proposed.

Proposal 67. This amendment proposes to delete § 33.29(b), which requires that each turbojet engine be provided with a connection for a rotor system unbalance indicator.

A commenter objects to deletion of the requirement for a connection for rotor system unbalance indication. The commenter states that a well-developed system has more than adequate reliability and has capability of giving advance warning of failures which could lead to hazardous events. Two commenters agree to the deletion of the requirement for rotor system unbalance indication. However, one of the commenters adds that airborne vibration monitoring (AVM) could be applicable to some engines and that in cases where reliable AVM systems have been developed, credit could be claimed for the AVM system in showing compliance with various FAR Part 33 (and Part 25) requirements as part of the basic engine type design. Recent experience has demonstrated that in some instances AVM can provide a safety improvement as discussed by the first commenter. Therefore, the requirement is being retained in Part 33 to provide an engine connection for AVM. Retention of the requirement does not impose a significant burden on the engine manufacturer. Accordingly, the proposal to delete § 33.29(b) is withdrawn.

Proposal 68. This amendment adds requirements for fluid injection (other than fuel) system controls under a new § 33.35(e).

A commenter suggests the proposal be changed to read: "the flow of the injected fluid is adequately controlled," and that paragraph (e) (2) be deleted. The commenter explains there exist systems which inject fluid at a fixed rate independent of power lever position. The commenter adds that some systems do not use pumps but utilize engine bleed air for pressurization and control it manually or automatically with power lever or throttle motion. The FAA agrees with the commenter, and the section is revised accordingly.

Proposal 69. This amendment to § 33.43 removes the requirement to comply with established shaft endurance stress limits when operating an engine with one cylinder not firing.

The single commenter concurs with the intent of this proposal but requests that shaft critical speeds for the cylinder-out condition be included in the operating instructions. The FAA considers that testing done under this section will provide safe operating information, including critical speeds, which must appear in the engine operating instructions in accordance with § 33.5. The proposed amendment is adopted without change.

Proposal 70. No comments were received on the proposal to correct a typographical error in § 33.49, and it is adopted without change.

Proposal 71. No unfavorable comment was received on the proposal to amend § 33.63 by deleting the word "normal," which tended to unduly restrict the operating range of rotational speeds when considering vibratory force and stress on engine and structure. The proposal is adopted without change.

Proposal 72. This proposed change to § 33.65 is based on a similar proposal deferred from Notice 75-31 (40 FR 29410; July 11, 1975) and was introduced into the NPRM after the Aircraft Engine Regulatory Review Conference held in January 1978.

The stated objective of this proposed change is to allow flightcrews to completely avoid surge and stall conditions severe enough to cause engine malfunction or damage.

One commenter agrees with the proposal with no amplifying statements. Another commenter, a rotorcraft manufacturer, expects this proposal would supply urgently needed quantitative operating margins. Considering the installation effects of rotorcraft applications, the FAA does not believe this proposal will alleviate the rotorcraft manufacturers' requirements for in-flight investigation of stall and surge characteristics (§§ 27.939 and 29.939).

The combined comments from the other respondents can be summarized as follows:

(1) The objective of the proposed change is commendable; however,

(2) Technology or state-of-the-art does not allow attainment of the objective as stated;

(3) The magnitude of testing, just in terms of variables that would need to be investigated, would be formidable and costly with little or no accompanying increase in safety;

(4) The FAA has not established documentation to justify such a rule change;

(5) An appropriate advisory circular should be issued and coordinated with industry prior to changes to this regulation;

(6) Terms such as "severity of the surge and stall" are ambiguous and unamenable to quantitative testing; and

(7) The current regulation adequately provides the desired information.

At this time, the FAA concurs with the first six items above. It further concurs that item (5) may be the first approach to correcting any FAA disagreement with item (7).

As stated under the "Explanation" of the proposed rule, the current rule is objected to for not being able to define an acceptable or rejectable degree of compliance. After further review, it is concluded that this same objection might apply to the proposed rule. Furthermore, the regulation as proposed will not meet the stated objective. The proposed regulation would still be subject to the interpretive process used to determine compliance during certification. Knowledgeable comments and other information received on this proposal make it doubtful that the objectives can be met at this time.

Considering the above, the FAA is at this time deleting this proposed change.

Proposal 73. This amendment to § 33.66 clarifies standards for bleed air system performance and for indication of the functioning of ice protection systems, if bleed air is used and can be controlled.

There were no dissenting comments. However, one commenter objects to the words "aircraft powerplant" in connection with the ice protection system, as the reader might confuse the engine anti-icing system with the aircraft anti-icing or ice protection system provided for the powerplant. The FAA concurs with the comment to use the word "engine" in place of "aircraft powerplant," and the proposal is modified accordingly.

Proposal 74. This amendment to § 33.67 brings engine fuel system standards into conformity with corresponding sections of the aircraft rules. It also adds new fuel control standards.

Since a large number of comments were received on the various sections of the proposed rule, the following discussion has been subdivided into segments for simplicity of discussion.

Ref § 33.67(a). Although no unfavorable comment was received on the proposal to amend § 33.67 by deleting all but the first sentence of § 33.67(a), the dropping of proposed § 33.67(d) introduces the need to restore, in § 33.67(a), the requirements for proper fuel control system functioning, adjustment, locking, and sealing. Therefore, the proposal is modified by deleting only the last sentence of § 33.67(a).

Ref § 33.67(b). A commenter states the proposed revision should specify that the fuel strainer or filter be installed ahead of the first engine fuel system component which is susceptible to restricted fuel flow due to contaminants. The commenter adds that this would assure that the complete engine fuel system is protected from fuel flow interruption due to contamination.

While there is merit to considering amending § 33.67(b), it goes beyond the scope of the present NPRM. These comments should properly be handled by a future NPRM to allow other interested persons time to submit their views. Therefore, the proposal is adopted without change.

Ref § 33.67(b) (3). No comment was received on the proposal to amend § 33.67(b) (3). Accordingly, the proposal, with respect to § 33.67(b) (3), is adopted without change.

Ref § 33.67(b) (4). A commenter suggested that the last sentence of proposed § 33.67(b) (4) be amended to read: "The applicant must provide evidence. . . ." This is intended to provide experience or alternative means, other than testing, for showing compliance. The FAA agrees that the word "demonstrate" as used in this paragraph would mean to prove by operation of the device, which was not intended as the only acceptable method of substantiation. Therefore, the proposal is modified accordingly.

Ref § 33.67(b) (4) (ii). A commenter suggests deleting proposed § 33.67(b) (4) (ii) and replacing § 33.67(a) with the sentence: "Each fuel system must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80°F and having 0.75 cc of free water per gallon added and cooled to the most critical conditions for icing likely to be encountered in operation." The commenter adds that manufacturers should be allowed to show that the total fuel system is capable of operation under those conditions without establishing any specific design criteria such as use of heaters or additives. The commenter further states that some current successful systems use neither anti-icing additives nor fuel heaters.

Another commenter states that although it may be reasonable to accept that a fuel heater can cope with water saturated fuel, the effectiveness of anti-icing additives should be evaluated.

The commenter suggests that the second sentence of § 33.67(b) (4) (ii) be amended to read: "This requirement may be met by showing the effectiveness of specified approved fuel anti-icing additives or that the fuel system is fitted with a fuel heater which is capable of maintaining the fuel temperature at the fuel strainer or fuel inlet above 32°F (0°C) under the most critical conditions."

The FAA does not agree with the first commenter since the proposed change does not restrict the manufacturer to specific design criteria, but rather provides for recognized equivalent means of compliance.

The FAA substantially agrees with the suggestion of the second commenter which rectifies the objections raised and which editorially corrects the proposed changes. Accordingly, the second sentence of proposed § 33.67(b) (4) (ii) is revised except that the words ". . . which is capable of maintaining . . . ." are further changed to ". . . which maintains. . . ."

Ref § 33.67(b) (5). A commenter strongly supports the substance of the proposed revision to § 33.67(b) (5) to require demonstration of filter capability that is related to fuel contamination ". . . likely to be encountered in service. . . ." Another commenter suggests quantifying the degree of contamination to provide a consistent unambiguous requirement which can be applied fairly and consistently. Two commenters suggest the proposal be canceled and the present wording be retained since engine control system malfunctions due to fuel contamination are not a service problem.

Proposed § 33.67(b) (5) is clarifying; however, the rule for engine certification should not relate to ambiguous aircraft flight requirements, but rather to the time of continued satisfactory engine operation in the mode of partial filter blockage.

Also, there is merit to the comment relative to quantifying the degree of contamination; but, further research is required before such limits can be established. Accordingly, proposed § 33.67(b) (5) is revised as discussed.

Ref § 33.67(c). Two commenters suggest the proposal be changed to read: "(1) The flow of the injected fluid is adequately controlled," and one of the two commenters further suggests deletion of (2). The commenters explain there exist systems which inject fluid at a fixed rate independent of power lever position. The second commenter adds that some systems do not use pumps but use engine bleed air for pressurization and control it manually or automatically with power lever or throttle motion. A third commenter suggests that the flow of injected fluid must be controlled in relation to the design requirements of the engine since power produced by an engine can be influenced by a number of factors. The FAA agrees with the commenters and has revised the section accordingly.

Ref § 33.67(d). A commenter suggests that the proposal should provide for consideration of electric/electronic components which have a documented satisfactory service history. Two commenters state that it seems unnecessary to apply the proposed rule to other than full-authority control systems with electrical or electronic input.

Ref § 33.67(d) (1). One commenter suggests deletion of this section of the proposed rule on the basis that definition of reliability level would be subjective. Two commenters state that a comparative reliability level should not be imposed, the first since it was never required of hydromechanical units and the second since a comparable hydromechanical control for a given engine type may not exist. One of the commenters suggests that electronic control system reliability should be based on in-flight shutdown rate. The same commenter questions the meaning of ". . . combined level."

Another commenter states that adequacy of the secondary systems in controlling the engine for continued flight can only be determined by evaluation on the specific aircraft in conjunction with minimum crew requirements. It is noted that the requirement for continued safe operation of the installed engine after failure or malfunction is addressed in §§ 23.903, 25.903, and 29.903. However, the FAA agrees that the proposed wording is not completely consistent with engine certification requirements.

Another commenter submits a counterproposal which it is claimed will permit control functions not historically available with hydromechanical controls and will allow dispatch of an airplane with one channel of a dual system inoperative.

Another commenter supports the substance of the proposal and suggests the requirement be extended to other components susceptible to external electromagnetic interferences. The FAA agrees that the rule should be so extended; however, since the suggestion is beyond the scope of this review, the commenter is invited to submit it in proposal form for future consideration.

Ref § 33.67(d) (2). Two commenters suggest revising proposed § 33.67(d) (2) to read "Provide a means to monitor the operational status of each function critical for safe engine operation." Another commenter states it is not clear how monitoring the operational status can assure redundancy. The commenter adds that the designer should be permitted to establish compliance in a manner best suited to his particular design.

Ref § 33.67(d) (3). One commenter suggests that the term "independent power source" be clarified to more clearly state the intent. Two commenters suggest the proposal be revised since it is unnecessary to have an independent power source on the engine where a backup hydromechanical control is used in the event of power supply failure.

Ref § 33.67(d) (4). A commenter states that the proposal is too specific and that the engine manufacturer should be permitted to establish the power supply and environmental condition characteristics, including lightning or other electromagnetic interference, in which the control system will satisfactorily operate.

The scope of comments to § 33.67(d) has been extensive and raised several valid points and suggestions. Due to the extent of these comments, it is believed a major modification to this proposed change is required. Therefore, proposed § 33.67(d) is withdrawn. After reevaluation, another NPRM will be published, and the public will be given an opportunity to comment.

Proposal 75. This amendment to § 33.68 revises the requirements which govern performance under icing conditions.

A number of commenters support the proposed exemption of rotorcraft from the ground idling icing requirements, basing their justification on the unique characteristics of rotorcraft and rotorcraft operations. Others who wish to include rotorcraft under this rule point out, for instance, that oil rig operations may include lengthy loading cycles in icing conditions with rotors turning.

One commenter points out that wheel-equipped rotorcraft awaiting departure clearance can be subjected to the same delays as fixed-wing aircraft in foggy weather with temperatures conducive to induction system icing. The FAA agrees that, as a general practice, rotorcraft cannot expect preferential handling or to avoid queuing up at runways. Furthermore, the operation of a helicopter rotor system can itself, within the proposed envelope:

(1) Intensify icing conditions when ground fog or freezing drizzle under stable cloud layers is present; and

(2) Generate freezing ground fog when atmospheric conditions are close to forming natural freezing fog.

Other commenters contend that no rotorcraft have been certificated for intentional flight in icing conditions. The FAA considers this contention somewhat irrelevant in considering ground induction icing conditions. As mentioned above, ground operation can produce induction system icing without the existence of conditions conducive to in-flight icing as defined in Appendix C of Part 25 of the FAR.

Considering the above, and after further review, the FAA sees no justification for excluding rotorcraft from § 33.68(b) and has revised the proposal accordingly.

It also is suggested that a certification time of less than the 30-minute idle specified in the proposed amendment could be applied to rotorcraft engines. This suggestion may have merit, but it is believed that additional operating data are required to support a lower test time. This question will be considered in future rulemaking.

Concerning the envelope to use for testing, one commenter suggests using more general terms to describe the icing envelope, while another suggests adoption of a somewhat more severe military specification.

As was presented during the Aircraft Engine Regulatory Review Conference, recorded meteorological data, from the most severe ground icing experience during civil operation, does not support more stringent criteria. Therefore, the FAA does not agree with the proposal to adopt the military specifications.

In response to the comment to state the requirements in broad terms, the proposed regulation as stated presents minimum atmospheric parameters for all engines to meet. A lack of specific requirements could lead to a generation of engines all meeting different atmospheric conditions. This would not lead to uniformity in the certification process.

One comment was received opposed to allowing periodic engine run-up to shed ice. The comment was based on the possibility of icy taxiways and run-up pads making this procedure risky. The FAA agrees that this comment has merit under certain conditions. However, there are installations where this procedure could be perfectly acceptable under adverse ground conditions. Rotorcraft operation is one such application. The relaxatory nature of this part of the regulation need not be denied applications where safety is not compromised. It should be noted that the manner of this procedure may be controlled by limitations in the engine data sheet and/or operating instructions if appropriate. It is envisioned that run-up power excursions that are excessive or operationally untenable will be disallowed.

Therefore, with the exception of the change to § 33.68(b) discussed earlier, the proposal is adopted without change.

Proposal 76. This amendment to § 33.71 revises the standards for engine lubrication systems and makes them consistent with proposed §§ 23.1019 and 23.1021 and corresponding changes to Parts 25, 27, and 29.

A commenter disagrees with the proposal to delete the requirement for a strainer or filter ahead of each scavenge pump, stating that protecting the scavenge pump is essential to safe operation. The commenter adds that the rule already allows the applicant to size the strainer as needed to protect the pump. The FAA believes that design flexibility should be carried even further and that the need for a scavenge strainer/filter and its sizing should be determined by the engine designer.

Another commenter suggests that § 33.71(b) be further amended to read: "There must be an oil strainer or oil filter, other than at the oil tank outlet, through which all of the engine oil flows." However, this change would not provide additional clarity and would add an unnecessary restriction.

A commenter suggests that § 33.71(c) (5) be amended or deleted to permit marking the word "oil" on adjacent cowlings instead of the engine oil tank oil filler and that the corresponding aircraft rule be amended to conform. Sections 23.1557, 25.1557, 27.1557, and 29.1557 already specify exterior markings as suggested by the commenter. The proposed oil tank filler marking drops the capacity requirement from the current rule but retains the "oil" marking in the interest of safety.

A commenter suggests that proposed § 33.71(c) (12) (ii) call for provision of makeup oil equivalent to that expected to leak from a deteriorated engine. The FAA believes that this requirement is implicit in the proposed rule and would have to be met by airworthy engines under §§ 33.19 and 33.75.

A commenter suggests that proposed § 33.71(f) be deleted because loss of lubrication during "negative g" operation has not been a problem in commercial service. Another commenter suggests deleting the reference to § 25.333 in this section since engines for general aviation fixed-wing and rotary-wing applications do not necessarily comply with it. The commenter further suggests that the amendment require the applicant to define the maximum applied loads as in § 33.23 for mounting attachments. The FAA has no records to indicate the extent of the problem with engine lubrication during negative g operation, and it is correctly noted that a Part 25 requirement should not be imposed on an engine not intended for Part 25 application. The present regulations covering lubrication system design for both reciprocating and turbine engines have been found adequate. The proposed new paragraph (f) is withdrawn as recommended, and the remainder of the proposal is adopted without change.

Proposal 77. This amendment adds a new § 33.74 which defines thrust or power augmentation systems for transport category airplanes.

After further consideration, the FAA has found it to be impractical for an engine manufacturer to comply with § 25.945 as referenced in the new section since this paragraph requires detailed knowledge of the aircraft engine installation, aircraft flight envelope, and power augmentation system hardware supplied by the manufacturer for each aircraft type. This information is seldom available to the engine manufacturer at the time of engine certification. The proposed amendment therefore is withdrawn.

Proposal 78. Two commenters object to the word "hazardous" as proposed for § 33.75, which amplifies and redefines burst limits and corrects a reference to allowable loads in amended § 33.23. They submit that an engine manufacturer is not in a position to judge what is hazardous at the time of engine certification. The commenters recommend using "release of fragments having significant residual energy" as the burst criterion.

The FAA disagrees. Released fragments are important because they may represent a hazard to the aircraft. The hazard may be related to residual energy, but even fragments which have a low residual energy may constitute a hazard. Judgment must be used under either definition by the manufacturer and the FAA during certification to determine what is hazardous. Section 33.75(b), therefore, except for the descriptive parenthetical statement, is adopted as proposed. Reference to § 33.23(b) (2) in proposed paragraph (c) is corrected by substituting § 33.23(a).

Proposal 79. This amendment adds a new § 33.76, which applies the standards of § 25.933, airplane reversing systems, to engine airworthiness.

Two commenters object to the proposed amendment on the grounds that compliance requires an evaluation of the system thrust reverser as a part of a particular aircraft reversing system. The engine manufacturer cannot anticipate or have available the aircraft design and performance data necessary to comply with § 25.933(a) and (b). The FAA agrees, and this proposal is withdrawn.

Proposal 80. This amendment to § 33.77 updates the engine foreign object ingestion requirements. For comments on the amendment to § 33.77(a) (2) and (a) (3), see the proposals for § 33.75(b) and (c), respectively.

A commenter expresses the opinion that ingestion tests should be conducted with simulated engine installation hardware and gearbox loading. The FAA finds merit in these comments but considers the suggested changes beyond the scope of the NPRM. The FAA will review these suggestions for future rulemaking action.

A commenter questions whether an engine running for 5 minutes following the bird ingestion event is adequate. In the absence of an obviously dangerous condition, however, the 5-minute run time is sufficient to demonstrate engine integrity. This commenter also suggests that in addition to the other requirements, any potentially hazardous physical damage following the bird test be considered a failure. The FAA has made this a practice in the past, and the section is changed accordingly.

A commenter submits information from an actual aircraft accident which suggests that bird ingestion certification requirements should be made stricter. The accident cited involved an engine certificated before the current requirements were adopted at a time when less demanding tests were the rule, so that the commenter's remarks may not be currently relevant. The FAA is continually reviewing bird ingestion incident data in terms of possible rulemaking action.

A commenter objects to deletion of the sand and gravel ingestion requirement, stating that the absence of sand/gravel ingestion problems in service is due to the presence of the requirement in the current rule. The commenter points out that in addition to blade erosion, adverse effects on engine seals, bleed ports, and oil sumps may lead to in-flight operating abnormalities. Although it is recognized that sand and gravel ingestion may adversely affect various turbine engine mechanisms, service experience has shown that ingestion of these materials does not possess the potential for causing sudden loss of engine power as does other ingested matter. On this basis, the requirement is withdrawn.

A commenter points out that the specified 4 percent water to air ratio is less than that which may be encountered in the atmosphere and also suggests conducting water ingestion tests at altitude conditions. The FAA agrees that in some severe rain conditions, the water to air ratio exceeds 4 percent but considers that such occurrences represent an environmental extreme rarely encountered in service. Incorporating an increased water-to-air ratio or imposing altitude conditions on the water ingestion requirements are beyond the scope of this review. The FAA will continue to review ingestion test requirements for possible rulemaking action in the future.

Several commenters question the requirement to maintain a 4 percent water-to-air ratio during acceleration and deceleration of the engine. Two of these commenters also question how evaporative effects are to be accounted for in the water-to-air ratio. It is suggested that the wording of § 33.77(c) be changed to "while ingesting water following stabilized operation. . . ." The FAA intends that the 4 percent water-to-air ratio be maintained during transients to simulate actual conditions. It is not expected that this ratio will be maintained exactly but that a minimum of 4 percent water-to-air ratio will be used during transients. The practicality of such testing has been demonstrated.

The goal of water ingestion tests is to simulate flight in heavy rain in which saturation of the air is assumed. If the engine air available during the certification test is not saturated, additional water must be added to ensure a 4 percent liquid water-to-air-ratio at the engine inlet. The proposal for § 33.77(c) is changed to clarify this intent.

A commenter recommends that § 33.77(d) be further amended to require protection from pieces of objects which, although unable to pass through the protective device when whole, may break apart upon striking the protective device and enter the engine. This protection is already provided under proposed § 33.77(d) since it does not exempt from demonstration foreign objects of a size which will pass through the protective device.

Two commenters recommend further amending § 33.77(d) (3) to read ". . . sustained reduction in power or thrust greater than those values required by paragraphs 33.77(b) and (c)." The FAA agrees. The intent is not to require greater thrust recovery for engines with protective devices than for those without them. The proposed rule is changed as recommended.

One commenter disagrees with the wording of § 33.77(e) under ice test quantity. The words "typical inlet cowl" are intended to mean an inlet cowl typical of an installation of the engine being tested. The "slab of ice" is intended to be of a size and weight which provides a test of at least equal severity to the inlet cowl and engine face ice accumulation. The meaning of these phrases is clear, and the proposed wording is adopted.

One commenter objects to the proposed distinction in § 33.77(e) between engines with inlet guide vanes and engines without inlet guide vanes in the 4-pound bird ingestion test conditions. The commenter states that service records do not justify such a distinction and that bird ingestion is an environmental condition not related to fan/inlet design. However, there is reason to distinguish between turbine engines with and without inlet guide vanes in order to test each design under its most critical bird ingestion condition. This does not imply a difference in environment but is believed to provide the best test for each design type. FAA report No. FAA-RD-77-55, "Improved Resistance to Engine Bird Ingestion," dated March 1977, indicates that rotating blade damage is inversely proportional to the entering velocity of the bird due to the addition of the bird velocity vector and the blade velocity vector. An engine with inlet guide vanes is likely to be struck on a vane rather than a blade, and the vane damage will increase with increasing bird velocity. The proposed wording is retained. The FAA will continue to study the bird ingestion hazard.

Proposal 81. This amendment to § 33.83 broadens the vibration test requirements and affords added flexibility to the test methods.

Two commenters suggest that the title be changed in order to better describe the purpose of the test and avoid confusion with §§ 33.33 and 33.63. The FAA disagrees. Section 33.33 is a requirement for the design of reciprocating engines, § 33.63 is a similar requirement for design and construction of turbine aircraft engines, while § 33.83 relates to the block testing of aircraft turbine engines. Section 33.63 is a design consideration for turbine engines, whereas § 33.83 is a substantiation means.

Two commenters object to the use of the term "maximum permissible takeoff speed" since takeoff speed may not be the maximum permissible speed for certain engines. The FAA agrees, and the word "takeoff" is deleted from the first sentence of § 33.83(a).

Three commenters object to the wording of § 33.83(b) concerning acceptable methods for showing compliance. One commenter suggests that stress margins which are appropriate to the components being evaluated be recognized, while the others maintain that compliance can be shown by engine test as well as by analysis. The FAA agrees with both comments but believes the proposed wording is adequate. Each method of showing compliance with this section during the certification process is reviewed by the FAA.

Another commenter suggests insertion of the word "hazardous" before "failure" in § 33.83(a). The commenter points out that there could be minor failures during this test. The FAA considers that all failures should be evaluated in terms of each engine design, as the distinction between minor and hazardous conditions cannot always be pre-established for a new design.

A commenter suggests that some clarification of the term "loading device" would be of assistance. As used in this regulation, the term "loading device" (i.e., dynamometer) applies primarily to turboshaft and turboprop engines. Turbofan and turbojet engines are not usually loaded externally during the endurance test. The intent of this regulation is to assure that the turboshaft and turboprop engines are loaded in the same manner as during the endurance test.

The amendment to § 33.83 is adopted as proposed except for the change described.

Proposal 82. This amendment to § 33.87 clarifies the 150-hour endurance test procedure, provides alternative means of compliance, and adjusts the test schedule for helicopters.

One commenter questions the validity of conducting the endurance test of an accessory drive and mounting attachment on a separate rig, as provided by proposed § 33.87(a) (6). The commenter suggests that rig testing be supplemented by running the accessories on an engine. The FAA has found that when properly conducted, the gearbox rig tests with accessory loading provide sufficient data for endurance certification. In addition, such tests are often a more practical solution to the problem of environmental control and data collection encountered during endurance engine running. The accessory weights and overhung moments must be simulated during full engine testing, but power extraction effects may be substantiated by rig test.

A commenter suggests eliminating operation at rated 2½-minute power during the third and sixth takeoff power periods for one of the twenty-five 1-hour sequences specified by current § 33.87(d) (1). The commenter argues that proposed § 33.87(d) (2) increases the cumulative endurance test time at the 2½-minute power condition and that the increase should be compensated for in § 33.87(d) (1). The FAA does not agree. One reason for including proposed § 33.87(d) (2) is to establish a margin of safety for the 2½-minute power rating. Compensating for the increased time at 2½-minute power would cancel, to some extent, the intent of this proposal. The FAA recognizes that the total time required at 2½-minute power will be increased by 5 minutes but does not consider this increase to be significantly burdensome. However, the wording of proposed § 33.87(d) (2) is revised to make it clear that the 5-minute test at 2½-minute power is to be included within, rather than in addition to, the 30-minute test period.

One commenter requests that an "Emergency Power Rating" (EPR) be established for rotorcraft. The EPR would be a power greater than 2½-minute power and used for one engine inoperative takeoff in multiengine rotorcraft. The EPR would be permitted for up to a 30-second duration. The commenter proposes that the 30-second EPR be included in the 150-hour endurance test in this section. The FAA finds that although this proposal has merit, it is beyond the scope of the Engine Review. Therefore, the amendment to § 33.87 is adopted as proposed except for the changes described.

Proposal 83. This amendment to § 33.88 relieves the overtemperature test requirements by reflecting actual conditions more realistically.

One commenter recommends less reduction in test time than that proposed and suggests that such a reduction be made based on analysis of service experience that shows this to be acceptable. The commenter also recommends that the second sentence be revised to state that the turbine assembly be within dimensional limits established for allowing it to remain in continued service.

The FAA does not agree that the time reduction is drastic since engines certified before Amendment 33-6 were in fact tested for the 5-minute condition. Service experience with these engines, with regard to overtemperature capability is excellent. Additionally, all post-Amendment 33-5 certified engines have been granted exemptions from the existing 30-minute requirement and were tested for 5 minutes as is now proposed. The dimensional limits quoted in the proposal are in fact service limits as suggested by the commenter, which are determined during the certification process. Therefore, the FAA finds further clarification to be redundant.

Another commenter objects that the engine overtemperature test requirements inherently involve blade creep life, which is considered an economic item rather than an airworthiness item. The commenter states that the true need is to evaluate rotor disc integrity under conditions of possible overtemperature due to disc cooling system failure which might result in temperatures higher than the specified 75°F above maximum rated. The FAA position is that the regulation will ensure that the turbine assembly can satisfactorily withstand an overtemperature of 75°F above the maximum operating temperature for a period of time consistent with what could reasonably be expected in service. The test is designed to evaluate gross effects of a 5-minute overtemperature condition on the engine turbine assembly, which includes blades, discs, drums, spacers, shafts, seals, stators, nozzles, and support structure. Therefore, § 33.88 is adopted as proposed.

Proposal 84. This amendment to § 33.89 broadens the operational test requirements by calling for testing, if necessary, throughout the operating envelope of the engine.

A commenter complains that the tests do not demonstrate that rapid throttle movement does not constitute an operational hazard. It should be noted that § 33.89(a), through reference to § 33.73, requires demonstrating rapid throttle movement from minimum to maximum position. This commenter also considers it unreasonable to expect flight crewmembers to monitor engine controls during emergency conditions. The FAA, on the contrary, considers it reasonable to expect pilot monitoring and appropriate manipulation of engine controls within the context of the operational situations addressed by this comment.

One commenter objects that the proposed change has the same meaning as the current regulation while being less explicit. However, the proposed amendment contains all of the previous considerations implicitly within the new wording and at the same time has been expanded to include the entire operating envelope of the engine. Accordingly, the proposed rule is adopted without change.

Proposal 85. This amendment to § 33.90 discontinues use of the word "overhaul" and recognizes the validity of alternative maintenance programs.

One commenter suggests that the rule approve the process of reconditioning after test and inspection if it is determined that such process is required. The FAA agrees that if the test results show that maintenance action is required, it should be so specified. Another commenter suggests that substituting "initial maintenance inspection" for "overhaul test" merely replaces one contentious phrase with another and urges that § 33.90 be deleted as being unnecessary to safety. The FAA does not agree since not all Part 33 turbine engines come under the regimen of a structured reliability program. Recent experience with two new engine certification programs under current rules has shown the need for an initial inspection interval of certain hot section components. Significant deterioration of engine operating and performance characteristics would exist without the specified inspection and repair requirements. Accordingly, the proposed amendment is adopted with the change noted above.

Proposal 86. This amendment to § 33.92 deletes the windmilling test requirement for subsonic turbine engines and amplifies the rotor burst and load limitations as in the proposal for § 33.75(b).

In addition to comments previously discussed for § 33.75, two commenters question deleting the windmilling test requirement for subsonic engines. The commenters suggest that existence of the current requirement may account for the lack of service problems associated with windmilling engines. The FAA disagrees. Most engines currently in service have a certification basis which predates the windmilling test requirement of § 33.92 but, nevertheless, have accumulated years of service with no reported incidents of windmilling hazards. It has not been demonstrated that an engine test of windmilling capability is required for all subsonic engines.

One commenter recommends adding a requirement that the applicant provide evidence to show that the engine windmilling without lubricating oil would not result in a condition which would jeopardize the aircraft. The FAA agrees but believes that § 33.75 provides this assurance. Proposed § 33.92 therefore is adopted with the addition of the reference to mount load limits as proposed for § 33.75.

Proposal 87. No comment was received on the proposal to amend § 33.93(b) by substituting the word "part" for "component" to preclude ambiguity, and the proposal is adopted without change.

Proposal 88. This amendment provides a new § 33.94 which adds blade failure containment testing of engines for certification.

Several commenters object to the requirement of § 33.94(a) that the engine run for at least 15 seconds before initiating shutdown after the event, claiming that it is unduly restrictive. They state that an engine which shuts down in less than 15 seconds would be acceptable, provided it does not burst, catch fire, or generate excessive mount loads. The same commenters propose that § 33.94(a) (1) be changed to permit use of component rig containment tests to supplement the engine test whenever facility limitations prevent attaining maximum permissible speed on a complete engine.

The FAA agrees that certain engines may not be able to operate for 15 seconds after the failure event. Accordingly, § 33.94(a) is modified to allow for instances where the resulting damage prevents the engine running for the required 15 seconds.

The FAA agrees that rig tests are valid, as reflected in proposed § 33.94(b), and in fact manufacturers' rig tests are being used to supplement complete engine blade containment tests for certification purposes. It is concluded, however, that such determinations will be made on a case-by-case basis under the authority provided by proposed § 33.94(b).

Another commenter suggests that § 33.94(a) (2) should be changed so that the engine test is based on the most critical engine casing temperature rather than the most critical turbine blade. Analysis leading to determining the most critically operating turbine blade would be expected to include analysis of case material properties at critical temperatures in an engine operating at maximum permissible r.p.m. Therefore, additional clarification is not considered necessary, and the amendment to paragraph (a) (2) is adopted as proposed.

REGULATORY EVALUATION

The FAA conducted a detailed regulatory evaluation which is included in the regulatory docket. Based on a review of available FAA data, cost data supplied by the Aerospace Industries Association (AIA) and the General Aviation Manufacturers Association (GAMA), and data from the National Transportation Safety Board (NTSB) accident data file, FAA determined that this overall rule provides cost savings that substantially outweigh the additional costs imposed on society.

The amendments in this final rule provide benefits in the aggregate to the aviation public, most specifically to airframe and engine manufacturers. These amendments provide general benefits by deleting obsolete requirements and clarifying the text, by updating and modernizing technical requirements to reflect engineering advances in the state-of-the-art, by reflecting the changing interface between the airframe and engine manufacturers, and by taking into account FAA accumulated service experience. This rule imposes no costs on the Federal Government.

Industry estimates of costs and benefits provided to the FAA for specific amendments were aggregate undiscounted 10-year estimates stated in 1981 dollars. The FAA was unable to break down these aggregate estimates into annual estimates because of the uncertainty of the number of new type certificated engines and aircraft models in a given year as well as the subsequent production of these engines and aircraft in a given year. Furthermore, industry was unwilling to supply information pertaining to the number of companies impacted by each of these amendments, or specific information on the number of estimated new type certificated engines and aircraft in a given year as well as subsequent production estimates, for reasons of individual company confidentiality.

Since it was assumed the Aircraft Engine Regulatory Review initiative would become final rule in 1983, the FAA adjusted the cost estimates to 1983 dollar values and then discounted these values for the years 1984 and 1992 to arrive at a range of values for the 10-year period of 1983–1992. The FAA did this because it was not known in which of these years the costs and benefits associated with the proposals would occur; therefore, by discounting the values in 1984 (assuming all benefits and costs occur in this year would result in the highest possible discounted values) and in 1992 (assuming all benefits and costs occur in this year would result in the lowest possible discounted values), a representative range is developed. The discount rate for 1984 is 0.91 and the discount rate for 1992 is 0.38. This range was conducted for all beneficial or cost imposing proposals except § 23.903(b) where FAA was able to obtain more refined data.

Major Benefits—Regulatory amendments that are expected to yield major benefits are summarized below (first-order discounted cost savings are stated in 1983 dollars and represent the range of savings for the *10-year period* of CY 1983 through CY 1992):

1. Section 23.903—The proposal allows the use of satisfactory foreign object ingestion (FOI) service experience for turbine engines as an alternate to meeting § 33.77 in effect on October 31, 1974, or as subsequently amended, to be eligible for installation. Currently, an airframe manufacturer would have to conduct FOI tests on any inservice turbine engine that is installed on a new airplane even though the engine may have a satisfactory FOI service experience. Estimated discounted test cost savings from eliminating this requirement in terms of 1983 dollars are $2.11 to $5.05 million for the period of CY

1983–1992. Considerable cost could be imposed on airframe manufacturers that choose to install engines certified to Part 33 FOI requirements prior to October 31, 1974, on future type certificated airplanes that have a bad FOI service experience. FAA considers that those instances would be rare from a technological state-of-the-art standpoint.

2. Section 33.14—This proposal provides engine manufacturers with more latitude in the type of procedures they can use for establishing low-cycle fatigue service lives for rotating components and for increasing these lives. This proposal also increases the applicability of the rule, redefines the term "start-stop stress cycle," and permits an alternative to parts temperature stabilization if justified. The current rule is unduly restrictive, because it prescribes only a fixed reduction factor for determining the initial service life and only one method for increasing these lives based on testing of parts removed from service. Estimated discounted test cost savings in terms of 1983 dollars are $16.15 to $38.69 million for the period of CY 1983–1992.

3. Section 33.68—This proposal relaxes the 30-minute idle with freezing fog requirement test criteria, permits periodic engine runups, and permits temperature variation, all with regard to induction system icing. The current test requirement is unnecessarily severe because it is outside the maximum icing envelope of Appendix C of Part 25, and because no tolerances are permitted on the temperature and liquid water content. Program and production cost savings will be achieved through reduced anti-icing system hardware and installation costs and through simplification of the engine design and manufacturing process. Specifically, this amendment eliminates in almost all cases the design and installation of components for a supplementary heating system. Estimated discounted savings in terms of 1983 dollars are $214.02 to $517.17 million for the period of CY 1983–1992.

4. Section 33.71—This amendment deletes the requirement for scavenge oil strainers and marking oil tank filler capacity. Service experience shows that scavenge oil strainers do not necessarily improve safety but do tend to restrict design of the oil system. There is no safety need to mark tank capacity on the oil tank filler. Estimated discounted component, installation, and labor cost savings in terms of 1983 dollars are $2.11 to $5.05 million for the period of CY 1983–1992.

5. Section 33.77—This proposal eliminates the tire, sand, and gravel FOI test requirements. The tire test requirement is deleted because service experience has shown that hazardous consequences from ingestion of a piece of tire are no greater than those associated with ingestion of a 4-pound bird. Furthermore, service experience has shown that ingestion of sand and gravel does not possess the potential for causing sudden loss of engine power as does other ingested matter. Eliminating these requirements will result in some test cost savings and reduced hardware (engine) burnup. Estimated discounted test cost savings in terms of 1983 dollars are $9.62 to $23.02 million for the period of CY 1983–1992.

6. Section 33.83—This proposal allows the use in certain cases of a modified version of the endurance test loading configuration for the required vibration survey which would enable the use of a modified configuration if that loading device is incompatible with the necessary vibration instrumentation. The current regulation is unduly restrictive because it requires that the vibration survey must be conducted using the same configuration of the loading device which is used for the endurance test. A comparable test on the engine will serve the same results. Estimated discounted labor cost savings in terms of 1983 dollars are $4.18 to $10.01 million for the period of CY 1983–1992.

7. Section 33.87—This section allows separate, more convenient rig testing of accessory drives and mounting attachments. The FAA has found that gearbox rig tests with accessory loading provide comparable data to endurance certification tests. The current regulation requires that load testing of accessory drives and mounting attachments must be performed on the engine. The FAA has found this to be too stringent a requirement. There will be possible small cost savings in equipment to operate the accessory drive. Estimated discounted cost savings in terms of 1983 dollars are $1.17 to $2.80 million for the period of CY 1983–1992.

8. Section 33.88—This proposal reduces the duration of the overtemperature test from 30 minutes to 5 minutes. The current rule has been found unnecessarily severe since service experience has shown that none of the turbine engines subjected to 5-minute overtemperature tests have experienced inservice rotor disc primary failure due to overtemperature. Significantly reducing the duration of the overtemperature test adequately demonstrates the integrity of rotor discs without subjecting them to unnecessarily hazardous conditions and saves development of hardware for blades, discs, drums, etc. Estimated discounted test and hardware cost savings in terms of 1983 dollars are $9.03 to $21.62 million for the period of CY 1983-1992.

9. Section 33.92—This amendment deletes the windmilling without oil test for subsonic turbine engines. There have been no reported incidents involving windmilling hazards to aircraft resulting from loss of engine oil, and it has not been demonstrated that an engine test of windmilling capability is required. Estimated discounted test cost savings in terms of 1983 dollars are $0.96 to $2.30 million for the period of CY 1983-1992.

Major Costs—Regulatory amendments that are expected to impose major costs are summarized below (first-order discounted costs are stated in 1983 dollars and represent the range (except § 23.903) of new costs imposed for the *10-year period* of CY 1983 through CY 1992):

1. Section 23.903—This amendment requires that design precautions be incorporated in Part 23 certified airplanes to protect these airplanes from uncontained rotor failure events. As the use of turbine engines on Part 23 certified airplanes increases, especially in for-hire operations, airplanes certified under Part 23 should be afforded the same level of safety from uncontained rotor failures as airplanes certified under Part 25. The FAA obtained information pertaining to two cases in the past 10 years involving uncontained rotor failures in Part 23 certified airplanes. In terms of 1983 dollars, the cost of these accidents (injuries and aircraft damage) is approximately $1.1 million based on values contained in the *Economic Values for Evaluation of FAA Investment and Regulatory Programs*. Assuming that this proposed rule would protect against all uncontained rotor failure events, $0.93 to $2.2 million is the discounted exposure adjusted benefit (cost savings) range for a 10-year period beginning CY 1983. These estimates include the projected increase in the number of hours flown by turbine-powered general aviation airplanes. It is noted in both cases that uncontained rotor failure was the secondary cause of these accidents (incidents), both of which were precipitated by worn components in the gear assemblies according to the NTSB. It is also noted that this rule is proposed in order to prevent a future problem in certain Part 23 airplanes because installation of turbine engines in these airplanes is expected to increase significantly in the next 10 years. Furthermore, a significant increase in the number of Part 23 certified turbine-powered airplanes used in air taxi and corporate operations is expected, and the FAA believes that protection comparable to that required under Part 25 is needed when carriage of passengers is involved.

This requirement places an economic burden on the manufacturers of these small airplanes. This requirement may influence future airframe design in areas such as armor protection and engine location.

In an attempt to derive cost estimates, the FAA contacted GAMA and various airframe manufacturers. Most of these organizations indicated that the proposed regulation would impose significant costs, but they were not able to provide specific estimates because of the complexity of the issues, and the amount of time it would take to compile estimates. Additionally, the extent of specific design changes to future type certificated airplanes was not immediately known.

One industry organization estimates that the cost to the manufacturer of compliance per airplane could easily reach $20,000, including increased engine price, cost of materials, design, development, testing, tooling expense, labor, and normal factory overhead. Specifically, this organization stated that the typical engine would require a containment shield (using a Kevlar fabric which is believed to be the most weight efficient installation) and that design adjustments would be required to provide for proper cooling, assurance of cowling drainage, and access to service points. Furthermore, the organization stated that considerable engineering and flight test development would be involved in assuring that maintenance could be accomplished on the engine, and the development of ballistic confirmation tests and certification would be extensive. The FAA ascertained through discussions with industry that an estimated 10 new turbine-powered airplane models would be eligible to be certified to Part 23 standards during the next decade. Because it is not certain in what years these airplane models will be certified, the FAA assumes that one airplane will be certified each year from 1983 through 1992. Furthermore, the projected production levels for each of these models in future years is not known. Based on past production levels of certain Part 23 turbine-powered airplanes, the FAA assumes an average annual production of 75 airplanes for each newly-certified model in each year following the year of certification.

Using this assumption, 3,375 airplanes will be manufactured between 1983–1992 of models which were newly-certified to Part 23 during this period.

The following table shows that the discounted value of costs over the 10-year period of 1983–1992 in 1983 dollars of requiring design precautions to minimize rotor failure events is $37.8 million. It assumes that the cost of compliance per airplane is $20,000. These are first-order costs which are initially borne by the airframe manufacturer, and the costs do not take into account the effect of increased prices with respect to the impact on domestic sales and foreign competition implications.

Discounted Value of Costs of Proposed Rule

Year	*Airplane Production*	*Cost of Compliance per Airplane*	*Present Worth Discount*	*Discounted Value of Cost of Rule*
1983	0	$20,000	1.00	$ 0
1984	75	20,000	0.91	1,365,000
1985	150	20,000	0.83	2,490,000
1986	225	20,000	0.75	3,375,000
1987	300	20,000	0.68	4,080,000
1988	375	20,000	0.62	4,650,000
1989	450	20,000	0.56	5,040,000
1990	525	20,000	0.51	5,355,000
1991	600	20,000	0.47	5,640,000
1992	675	20,000	0.43	5,805,000
Total	3,375			$37,800,000

This rule would also impose certain second-order costs on purchasers of these airplanes in terms of increased inspection costs (removing and installing the system at each inspection interval) and decreased airplane performance due to a maximum 100-pound increase in airplane empty weight. The benefit/cost considerations may improve because increased use of turbine engines in Part 23 certified airplanes will increase the risk of rotor failure accidents.

2. Section 25.1091—This amendment requires that the FOI criteria of § 33.77 be applied to vulnerable portions of the air induction system such as inlet splitter vanes, duct-mounted instrumentation, and annular rings. Parts of the air induction system such as annular rings and splitter vanes are physically located in front of the engine. These parts were installed to reduce engine inlet noise in a limited number of airplanes. If these components are included, they should be subject to the same FOI requirements as the engine because of their possible breakoff into the engine. Most aircraft induction systems do not use splitters, etc., and therefore most aircraft engines would not be affected by this rule. This requirement was inadvertently left out of Amendment 33-6 in 1974. The estimates of the discounted cost range of improved materials and testing for these specific

Table 1[1]

Aircraft Engine Review Benefit/Cost Matrix By Major Amendment, for the 10-Year Period of CY 1983 Through CY 1992

($ in millions)

	FAR	*Benefits*	*Costs*
23	23.903(a) (2)	$2.11-5.05	$-
	23.903(b)	0.93-2.22	37.80
	Subtotal	3.04-7.27	37.80
25	25.1091(e)	-	2.11-5.05
	Subtotal	$ 0	2.11-5.05
27	none	-	-
	Subtotal	$ 0	0
29	none	-	-
	Subtotal	$ 0	0
33	33.14	16.15- 38.69	-
	33.68	214.02- 517.17	-
	33.71(b)	2.11- 5.05	-
	33.77	48.91- 117.11[2]	1.05-2.50
	33.83(a)	4.18- 10.01	-
	33.87(a) (b)	1.17- 2.80	-
	33.88	9.03- 21.62	-
	33.92(c)	0.96- 2.30	-
	Subtotal	$296.53-714.75	$ 1.05- 2.50
	Total	$299.57-722.02	$40.96-45.35

[1] Benefit and cost values are stated in 1983 dollars.

[2] Of this amount, $39.29 million to $94.05 million is the benefit attributed to an accident caused by water ingestion.

items to meet the criteria of § 33.77 in terms of 1983 dollars are $2.11 to $5.05 million for the 10-year period of CY 1983-1992. However, the actual cost of compliance will be much lower because compliance with FOI standards may be shown by analysis as well as testing, and the FAA sees little application of such devices in the future.

3. Section 33.77—This amendment requires that a 4 percent water-to-air ratio be maintained during transients in order to simulate actual flying maneuvers in heavy rain. The current rule requires that the ratio be maintained only for takeoff and idle conditions but does not require any demonstration of the ability to accelerate or decelerate safely under water ingestion conditions. Such ability is essential for safe flight in heavy rains. The FAA obtained information pertaining to one case in the past 10 years involving turbine engine failures due to water ingestion during transients, a Southern Airways accident in 1977. The NTSB reported that the probable cause of the accident was a loss of thrust of both engines while penetrating severe thunderstorms. The NTSB also reported the accident resulted from a loss of thrust caused by ingestion of massive amounts of water and hail which, in combination with thrust lever movement, induced severe stalling in and major damage to the engine compressors.

In terms of 1983 dollars, the cost of this case (injuries and aircraft damage) based on values contained in the *Economic Values for Evaluation of FAA Investment and Regulatory Programs* is approximately $47.0 million. Assuming that this proposed rule would protect against all accidents and incidents involving turbine engine water ingestion, $39.29 to $94.09 million is the discounted exposure adjusted benefit range (cost savings) for the period of CY 1983-1992. This estimate includes the projected increase in the number of hours flown by turbine powered aircraft.

This amendment would require engine manufacturers to conduct a more precise water ingestion test and to collect more test data to verify engine performance as it relates to water ingestion. It could require the engine manufacturer to purchase additional test equipment. The estimated additional discounted cost to the engine manufacturers to perform this test in terms of 1983 dollars is $1.05 to $2.50 million for the period of CY 1983-1992.

The first-order discounted benefit and cost ranges of these major proposals are summarized in Table 1. This table shows that the most conservative benefit/cost ratio for the entire evaluation is $299.57 to $45.35 million or 6.61 to 1.00.

ADOPTION OF AMENDMENT

Accordingly, Parts 23, 25, 27, 29, and 33 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, and 33) are amended effective March 26, 1984.

(Section 313(a), 601, and 603, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423); and 49 U.S.C. 106(g) Revised, Pub. L. 97-449, January 12, 1983).

NOTE: The FAA has determined that this amendment yields overall cost benefits by eliminating unnecessarily stringent design requirements and by simplifying and clarifying existing rules without reducing the level of engine installations. The amendment simplifies a number of technical requirements and removes administrative burdens on regulated persons and the FAA through amendment of regulations from which exemptions have been granted. Therefore, it has been determined that this is not a major regulation under Executive Order 12291. In addition, the FAA has determined that this amendment is not significant under the Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). The evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Amendment 25-58

Floor Proximity Emergency Escape Path Marking

Adopted: October 22, 1984 Effective: November 26, 1984

(Published in 49 FR 43182, October 26,1984)

SUMMARY: This amendment establishes new performance standards for floor proximity emergency escape path marking to provide visual guidance for emergency cabin evacuation when all sources of cabin lighting more than 4 feet above the aisle floor are totally obscured by smoke. This amendment makes the standards applicable to future type certification of transport category airplanes and, after November 26, 1986, to airplanes type certificated after January 1, 1958, and operating under Part 121. These standards represent a significant improvement in aircraft cabin safety and are in addition to the emergency lighting standards currently in the regulations.

FOR FURTHER INFORMATION CONTACT: Henri Branting, Technical Analysis Branch (AWS-120), Aircraft Engineering Division, Office of Airworthiness, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591; telephone (202) 426-8382.

SUPPLEMENTARY INFORMATION:

BACKGROUND

On August 23, 1983, the Federal Aviation Administration (FAA) issued Notice of Proposed Rulemaking (NPRM) No. 83-15 (48 FR 46218; October 11, 1983). This Notice proposed new performance standards for floor proximity emergency escape path marking to provide visual guidance for emergency cabin evacuation when all sources of cabin lighting more than 4 feet above the aisle floor are totally obscured by smoke. The Notice proposed to make the standards applicable to future type certification of transport category airplanes and to most airplanes operating under Part 121 of the Federal Aviation Regulations (FAR). These proposed standards would be in addition to the emergency lighting standards currently in the regulations.

The Notice responded to certain findings of the Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee and was based on the results of research, development, and testing conducted by the FAA.

The SAFER Advisory Committee was established in June 1978 by the FAA as a result of information from public hearings on aircraft fire safety. The FAA directed the Committee to "examine the factors affecting the ability of the aircraft cabin occupant to survive in the post-crash environment and the range of solutions available." The Committee consisted of 24 representatives of a wide range of aviation and general public interests. Technical support groups included approximately 150 of the world's top experts in fire research, accident investigation, materials development, and related fields. The Committee found that accident experience indicates smoke from burning fuel and cabin material can obscure overhead emergency lighting and make cabin evacuation difficult. Therefore, the Committee recommended that consideration be given to placing additional sources of lighting at a lower level in the relatively clear air near the cabin floor. The FAA accepted the Committee recommendation and conducted the research, testing, and design studies necessary to develop this proposed floor proximity marking concept.

Current regulations require that emergency lighting provide specific illumination at seat armrest level. The sources of this emergency illumination are typically located overhead in the cabin ceiling area. Service experience shows that the current regulations effectively ensure that the airplane's main aisles, cross aisles, passageways, and emergency exits are capable of sustaining rapid mass evacuation under critical conditions over a reasonably extended period of time. However, the regulations do not adequately cover the brief interval between the time buoyant hot smoke and gases might begin to fill the upper portion of the cabin and extend down to near floor level, obscuring all overhead lighting, and the time the cabin is not survivable. While this condition is extreme, it is considered desirable to address this in the aircraft design, and safety could be improved through the use of lights, lights and reflectors, or other devices to provide floor proximity emergency escape path marking.

The FAA conducted a series of laboratory tests to look into the problems of emergency lighting in conditions of dense smoke and to study practical ways of developing improved lighting systems for transport category airplane cabins. A design feasibility and cost study of floor proximity emergency escape path marking was conducted under FAA contract. The results of this study are published in FAA Report No. DOT/FAA/CT-83/31, Improved Interior Emergency Lighting Study, dated September 1983, available from the National Technical Information Service, Springfield, Virginia 22161. A copy of this report is in the docket available for inspection upon request. The economic analysis for the Notice was based on data from this study. Eleven candidate systems were considered in this study; and although individual systems were found to have certain advantages compared to others, no system was so clearly superior to the others that it warranted its establishment through regulation as the single standard for floor proximity emergency escape path marking in general. Notice 83-15 pointed out that there might be any number of combinations of point lighting, flood lighting, strip lighting, markers, signs, reflective materials, and other components that could adequately serve the objective of floor proximity marking. Therefore, the Notice proposed an objective performance standard rather than requiring a particular system. A performance standard in this case would allow industry the flexibility to choose among the various existing systems or to develop new systems.

The standard proposed in Notice 83-15 would require that floor proximity emergency escape path marking provide emergency evacuation guidance for passengers when all sources of illumination more than 4 feet above the cabin aisle floor are totally obscured. It proposed that in dark of the night conditions, the floor proximity emergency escape path marking must enable each passenger to: (1) Visually identify the emergency escape path along the aisle of the cabin floor after leaving a cabin seat; and (2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 4 feet above the cabin floor. The marking system performance would be proven under dark of the night conditions the same as those specified in the emergency evacuation demonstration requirements of § 25.803 of the Federal Aviation Regulations (FAR).

The proposal would require that airplanes type certificated after January 1, 1958, and operating under Part 121 comply with the new standard within 2 years after the standard became effective. The limited number of airplanes type certificated before January 1, 1958, operating under Part 121 were not included because the relatively advanced age and smaller sizes of these airplanes would make compliance impractical from an economic standpoint. The 2-year period was intended to allow air carriers lead time to schedule the modifications necessary for compliance to coincide with major maintenance inspections and, therefore, avoid an undue compliance burden.

Comments and data on marking systems capable of meeting the proposed performance standard were specifically requested in the Notice, with the stipulation that they would be considered in the publication of advisory material on acceptable means of compliance.

PUBLIC PARTICIPATION

These amendments are based on Notice 83-15. All interested parties have been given an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented. Except for the changes discussed below, these amendments and the reasons for their adoption are the same as those stated in Notice 83-15.

DISCUSSION OF COMMENTS

Twenty-four comments were received in response to Notice 83-15, representing the views of aircraft and equipment manufacturers, aircraft operators, aircraft crew organizations, U.S. and foreign government organizations, and consumer interests. All of the comments support the safety objective of the proposal, although various commenters disagree with certain technical aspects of the proposal.

Eight commenters disagree with the proposed applicability of the new marking requirements to airplanes certificated under FAR Part 25 and those operated under FAR Part 121. These commenters contend in general that applicability should depend on aircraft seating capacity, cabin size, type of operation, or similar factors. Four of these commenters oppose applicability to the relatively smaller airplanes with maximum seating capacities ranging from 30 to 60, depending on the view of the commenter. Three of the commenters favor extending the applicability to the type certification of rotorcraft and the operation of aircraft under regulations other than FAR Part 121, such as FAR Part 135.

Notice 83-15 did not address aircraft certificated under Parts 23, 27, or 29 or operations conducted under Part 135 because it was made in response to a recommendation by the SAFER Advisory Committee which limited its investigation to transport category airplanes. Notice 83-15 intended to establish additional requirements in Part 25 and Part 121 for the type of aircraft and operation for which emergency lighting is recognized as most critical and for which the most stringent lighting requirements have been established. Other regulations contain lighting and marking requirements considerably less stringent. The research, development, and testing and the feasibility and cost study which supported the proposal were based on the type of transport category airplane typically used in Part 121 operations. The proposal did not include rotorcraft or the types of airplanes operated under Part 135 because of their relatively smaller cabin sizes, shorter aisle lengths, and shorter seat-to-exit distances compared to transport category airplanes.

The FAA does not agree that applicability of these lighting requirements should be determined by the passenger capacity of an airplane operated under Part 121 or type certificated under Part 25. The transport category airworthiness standards require extensive emergency lighting and evacuation markings for all transport category airplanes, regardless of passenger capacity, although they do recognize that for relatively small cabins seating 9 or less passengers smaller evacuation markings provide the required level of safety and obviate the imposition of an impractical standard (since small cabins may not be able to accommodate larger exit signs). These cabins may use smaller emergency exit signs with lower illumination than the larger cabins. The objective performance standard will accommodate the "smaller" cabins by permitting the design of a marking system to suit the cabin size. Therefore, the applicability of the requirement is adopted as proposed.

Nine commenters express views on the 2-year compliance period in proposed § 121.310(c) (3). Three commenters favor increasing it to 3 years. Three favor accelerating compliance. Three concur with the 2 years. The comments favoring an increase to 3 years contend that the marking requirements are complex and that additional time should be allowed for development and approval of new designs, procurement of equipment, and the installation of systems.

The 2-year period will provide operators lead time to schedule modifications to coincide with major maintenance checks and therefore to avoid an undue compliance burden. The 2-year compliance period recognizes that the scheduling of major maintenance checks varies widely among carriers and individual airplanes depending on route structure and airplane utilization rate and in many cases exceeds 1 year. A significant reduction in the compliance period would conflict with the intent of the 2-year period and likely result in added airplane down-time for a number of carriers. The FAA anticipates that carriers operating large fleets of various types of aircraft may need more than 1 year to design, procure, and install the new lighting systems and to revise their technical manuals to include appropriate information and guidance regarding the new systems. Concerning extending the compliance period to 3 years, there is no indication in the comments that long-range modification scheduling could not begin some time during the design development and approval phase. Although the marking systems are not necessarily complex in design and construction, the 2-year period provides sufficient time for development and approval of new designs, procurement of equipment, and the installation of systems. Therefore, the 2-year compliance period is adopted as proposed.

One commenter contends the proposed standard infers that a separate floor proximity marking system is required. The standard, as adopted, does not require a separate system. A single system might meet the requirements for both general illumination and floor proximity marking.

Several commenters contend the wording of the proposed standard implies that marking/lighting is required along the aisle. One commenter says that aisle marking/lighting should not be necessary because a person leaving a seat needs no guidance to find the aisle, even in total darkness. The commenter says that with information provided by the pre-takeoff briefing and the passenger information card, the passenger will know the location of exits and, once in the aisle, can proceed to an exit, using the aisle as tactile guidance. Several commenters contend that marking/lighting should be necessary only for exits located off the main aisle.

The FAA agrees that visual guidance is not needed to enable a passenger to move from the seat to the aisle. The standard does not require this. The standard requires visual guidance for the aisle escape path and the exits. It does not require marking/lighting along the aisle, although this might be one means of complying with the standard. The standard does not preclude compliance by the use of conspicuous lighting or marking near the ends of the aisle or at other critical points along the aisle. The FAA does not agree that passenger exits on the main aisle need no floor proximity marking since without marking there would be no means by which passengers could readily identify the exits when overhead lighting is obscured. Notice 83-15 explains that under this objective standard, there might be many different combinations of point lighting flood lighting, strip lighting, markers, signs, reflective materials, and other components that could provide adequate visual guidance. The FAA does not agree with the commenter that tactile guidance alone for the aisle is sufficient. Under § 25.811(c), tactile guidance currently may be used for locating exits in dense smoke. For typical airline passengers unfamiliar with cabin features, visual guidance is more effective than tactile.

One commenter points out that in an actual fire, smoke might occur below the 4-foot level and that visual performance requirements should be based on defined optical density for smoke.

The FAA does not agree. It is impractical to define the fire scenario to this extent for the purpose of floor proximity marking design. In an actual fire, the obscuring layer might vary along the length of the cabin well above and below 4 feet. Notice 83-15 acknowledges that when lights are totally obscured at 4 feet, the effective height of clear air would be somewhat less. Four feet is a nominal design height, and the air below this is deemed clear for the purpose of floor proximity marking design.

Two commenters point out that floor proximity marking should not indicate a particular direction in which the passenger should move in an emergency, as this would depend on the nature of the emergency.

The FAA agrees. The proposed standard was intended to provide an indication to each passenger of the nearest exits forward and aft, thus giving the passenger a choice, depending on the location of the passenger's seat. The rule has been revised to make this intent clear. The direction in which the passenger chooses to move in an actual emergency would depend on conditions in the cabin.

In response to one comment, § 25.812(e) has been clarified by using the term "cabin aisle floor" throughout.

Many commenters express views regarding the objective form of the standard. While several commenters support the objective form, others disagree, contending that the lack of specific requirements leaves much of the compliance finding to subjective judgment and that this will not permit a uniform application of the standard throughout industry. Several commenters recommend revising the standard to specify the location, illumination, and luminosity of lighting, markers, and signs, similar to current regulations on emergency lighting.

Notice 83-15 explains why the proposed standard, for practical reasons, defines objective rather than specific requirements. The Notice explains that no marking system appears so superior to others that it warrants establishment as the single standard for marking in general. There is a notable difference between the general illumination, which is required in specific terms by current regulations, and floor proximity marking. General illumination is intended to enable a large number of passengers to orient themselves within the cabin, receive instructions and assistance from crewmembers, and queue up quickly at usable exits. General illumination is necessary for this. Non-illuminating markers will not suffice. Current regulations prescribe specific illumination for aisles and passageways. Floor proximity marking is intended to allow passengers who have become oriented within the cabin during the period of general overhead illumination to find their way to exits unassisted after the general overhead illumination becomes obscured. There are many combinations of lights, markers, and signs which might serve this objective in a cost beneficial manner, and each must be shown adequate for the particular cabin interior and exit arrangement in question. Therefore, a performance standard is used to allow design flexibility and at the same time ensure the necessary safety.

DISCUSSION REGARDING COMPLIANCE WITH THE OBJECTIVE PERFORMANCE STANDARD

Several commenters contend that because the objective performance standard does not specifically define a means of compliance, the FAA should publish advisory material concurrently with the rule adoption to provide guidance for the application of the standard. The FAA recognizes the value of guidance material for the introduction of a new performance standard. Notice 83-15 specifically requested comments and data on marking systems capable of meeting the proposed performance standard for use in the development of advisory material on means of compliance. Although the response to this request did not provide information on marking concepts which have been evaluated or found acceptable under the standard, it did identify those aspects of the standard for which additional clarification is appropriate.

In response to the comments, the discussion below addresses all aspects of the standard necessary for the development of a means of compliance. This discussion centers on the objective of floor proximity marking and the emergency conditions the marking is intended to counter. This information in conjunction with established FAA airworthiness evaluation and approval procedures will permit the determination of means of compliance which will ensure the consistent and uniform application of the standard. With this information, publication of additional guidance material is not necessary at this time.

Notice 83-15 explains that floor proximity marking is intended to counter conditions which might occur some time after the start of the type of emergency evacuation which is simulated in the demonstration required by § 25.803. In this demonstration, test subjects representing typical airline passengers in a cabin filled to capacity must evacuate the cabin in dark of the night conditions within 90 seconds, using emergency lighting only and with one-half the number of emergency exits rendered inoperative. Typically in a mass evacuation of this type, passengers immediately leave their seats and form queues at operable exits which generally are ready for use within 15 seconds. For the next 1 to 1½ minutes, the passengers in queues await their turn to escape through emergency exits and descend to the ground by escape slides. Emergency lighting is sufficient to enable the passengers to see the features of the cabin interior.

In actual emergency evacuation involving a fuel spill fire or cabin fire, smoke might begin to fill the upper portion of the cabin and eventually obscure emergency lighting and signs. This is the condition floor proximity marking is intended to counter. By the time this condition prevails in an emergency evacuation, the evacuee flows are most likely well established or completed. The floor proximity escape path marking is intended to enable unassisted passengers who might remain in the airplane to find emergency exits when overhead lighting is obscured.

A floor proximity emergency escape path marking system might be shown to meet the objective of the standard by means of the types of demonstrations discussed below or by means of analysis based on comparison of the marking system and cabin features with a marking system and cabin features previously approved by such types of demonstrations.

Demonstrations, if used, are a means to show that test subjects representing typical passengers can leave any passenger seat in the cabin and once in the walkway area immediately adjacent to the seat can proceed to the first exit, or pair of exits, forward and aft of the seat, and can make positive identification of the exits. A walkway area in this sense is an aisle or any other area beyond the seats which a passenger traverses to reach an exit. While demonstrations should not be necessary for each seat or seat row, they are appropriate for those walkway areas adjacent to passenger seats which are determined to be the more critical from the standpoint of visual reference and the objective of the performance standard. A sufficient number of demonstrations should be conducted to ascertain that test subjects can identify all of the passenger emergency exits in the cabin.

In a fire situation severe enough to obscure all overhead lighting, some passengers might find themselves alone or in nearly vacated sections of the cabin, without the benefit of crewmembers, queues of passengers, individual passengers, human voices, or other cues to aid them in finding and identifying exits. This would be the most adverse situation from the standpoint of orientation and sense of direction and would require the passenger, alone and unassisted, to rely solely on the visual guidance provided by the floor proximity marking system and the passenger's familiarity with the cabin exit arrangement acquired during the passenger briefing under conditions of general illumination. This situation should be accounted for in the demonstration of compliance.

Demonstrations should be conducted either during the dark of the night or during daylight with dark of the night conditions simulated. If the demonstrations are conducted during daylight hours, each window, door, emergency exit (open and closed), and other opening should have provisions to prevent daylight from entering the passenger cabin. Each internal door and curtain should be in the takeoff configuration. During the demonstrations, only the marking system subject to the show of compliance should provide light. Since the demonstrations pertain to visual reference and orientation, and not to egress performance and evacuation rate, the distribution of articles to create minor obstructions in the aisle, as mentioned in § 23.803(c)(11) for full-scale evacuation demonstrations, should not be necessary.

These demonstrations are intended to confirm the efficacy of floor proximity markings when all lighting more than 4 feet above the cabin aisle floor is totally obscured by dense smoke. Obviously, in an actual fire situation, illumination from the floor proximity system would be confined to within the 4 feet beneath the overlaying smoke and would not illuminate or reflect throughout the cabin in general. In a demonstration in which there is no overlaying smoke, illumination from the floor proximity system might reflect into the upper cabin and produce unrealistic illumination for the cabin and escape path. A single light might be sufficient to illuminate a large area of the cabin. Unrealistic reflections and illumination should be accounted for in demonstrations, either through a rational determination that they do not change the validity of the demonstration results or through the use of shielding or shrouding, if necessary, to minimize or eliminate their effects.

Persons used as subjects for the demonstrations should be ambulatory adults in normal health. Except for information obtained from the pre-takeoff briefing and passenger information card, and from the instructions given immediately prior to the demonstration, test subjects should not have practiced or rehearsed or have had the demonstration procedures described to them within the past 6 months. Crewmembers, mechanics, training personnel, and any other persons who are familiar with the interior features of the cabin through the normal course of their duties should not be used as test subjects. A test subject should not perform demonstrations for more than one walkway area.

For each critical walkway area in the cabin, demonstrations should be performed by at least the following test subjects individually: one male, one female, and one person over 60 years of age, male or female. Test subjects need not include children.

Prior to the demonstration, the test subject should be given a passenger information card and be in a seating area in a normally illuminated cabin in a position to see and hear the pre-takeoff passenger briefing required by § 121.571. One or more observers should be in the cabin. After the pre-takeoff briefing and shortly before the demonstration, the subject should be informed of the objective and procedures of the demonstration.

In each demonstration, the test subject acting alone and without assistance should be able to: (1) Leave the passenger seat or seat row and enter the walkway area immediately adjacent (Visual reference to the escape path marking need not be used to assist the test subject in locating the walkway area immediately adjacent to the seat or seat row); (2) Standing or stooping in the adjacent walkway area, identify from visual reference to the floor proximity marking system the direction(s) of the first exit or pair of exits forward and aft and indicate to the observer the means by which identification is made; (3) Traverse to those exits without significant hesitation, delay, or evidence of confusion; and (4) Make positive identification of the exits by visual reference to features not more than 4 feet above the cabin floor and indicate to the observer the means by which identification is made. The exits may be open or closed for the demonstration. Safety precautions should be taken for open exits. Identification should be made for at least one exit of each type and marking system in the cabin, in both the open and closed positions.

ECONOMIC ANALYSIS

One commenter states that the cost of engineering design, documentation, and demonstration should be added to the estimated costs. The FAA agrees and has increased the cost estimates by about 10 percent. For the 1983 aircraft fleet, the cost to retrofit is estimated to be $22.95 million, including the cost impact of additional weight. Another commenter states that the benefits cannot be quantified with any degree of accuracy. Clearly, it is impossible to accurately determine the number of persons who would have died in accidents involving fire who will now live because of this rule. However, decisions must be made relating to safety based on the best available information. The historical fire fatalities for the period 1965 through 1983 were 712. Extrapolating this fire fatality rate over the next 10 years, the expected life of the lighting system, the FAA estimates that about 10 percent of that number will have to be saved to justify the cost. The FAA's judgment is that a sufficient number of persons will be saved to justify the cost. The Regulatory Evaluation which has been placed in the docket contains a cost benefit analysis of the rule.

Trade Impact

These rules will have little or no impact on U.S. or foreign trade. In the United States, both foreign and domestic manufacturers must meet the proposed requirements, and there will be no competitive advantage to either. In foreign countries, there would be a minor cost advantage only if the foreign country did not require the floor proximity emergency escape path marking system. Since the cost of the marking system is negligible compared to the total costs of new aircraft, there is essentially no impact on trade.

CONCLUSION

Under the terms of the Regulatory Flexibility Act (the Act), the FAA has reviewed this proposal to determine what impact it might have on small entities. Since the projected cost of compliance could be between $5,500 and $17,400 for each aircraft in the Part 121 fleet, the FAA has determined that this rule, if adopted, may have a significant economic impact on a substantial number of small entities. Consequently, a regulatory flexibility analysis and regulatory evaluation has been prepared. It is contained in the docket which is open to public inspection. A copy of the evaluation may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

As required by the Act, various regulatory alternatives were considered, such as: Making the requirements applicable only to new airplanes, having different standards based on the size of the air carrier, letting the air carrier industry decide whether to use the new systems, and requiring all airplanes operating under Part 121 to come into compliance with the requirements within a certain time period. Safety needs are such that the FAA has selected the latter alternative set forth in these amendments. The alternative of making the requirements applicable only to new airplanes was rejected because of the delay this would cause implementing the new standards throughout the fleet. The alternative of having different standards based on the size of the air carrier was rejected because the FAA believes all members of the traveling public should be equally protected. The alternative of letting the air carrier industry decide whether to use the new systems was rejected because in the past a voluntary approach to new equipment has not resulted in fleetwide implementation of desired safety advances.

These amendments are not likely to result in an annual effect on the economy of $100 million or more or a major increase in costs for consumers; industry; or Federal, State, or local government agencies. In addition, these amendments will have little or no impact on trade opportunities for U.S. firms doing business overseas or for foreign firms doing business in the United States. Accordingly, it has been determined that this is not a major regulation under Executive Order 12291. In addition, the FAA has determined that this action is significant under Department of Transportation Regulatory Policy and Procedures (44 FR 11034; February 26, 1979).

ADOPTION OF THE AMENDMENT

Accordingly, Parts 25 and 121 of the Federal Aviation Regulations (14 CFR Parts 25 and 121) are amended effective November 26, 1984.

(Sections 313(a), 314(a), 601 through 610, and 1102 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1355(a), 1421 through 1430, and 1502); 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983)).

Amendment 25-59

Flammability Requirements for Aircraft Seat Cushions

Adopted: October 23, 1984 **Effective: November 26, 1984**

(Published in 49 FR 43188, October 26,1984)

SUMMARY: These amendments establish new flammability requirements for seat cushions used in transport category aircraft certificated under Part 25 and Part 29 and require that the cushions in transport category airplanes type certificated after January 1, 1958, and operating under Part 121 comply with these new requirements after November 26, 1987. These new requirements are in addition to the present flammability requirements contained in the Federal Aviation Regulations and represent a significant advancement in aircraft fire safety.

FOR FURTHER INFORMATION CONTACT: Henri Branting, Technical Analysis Branch (AWS-120), Aircraft Engineering Division, Office of Airworthiness, Federal Aviation Administration, 800 Independence Avenue, SW., Washington, D.C. 20591; telephone (202) 426-8382.

SUPPLEMENTARY INFORMATION:

BACKGROUND

On August 23, 1983, the FAA issued Notice of Proposed Rulemaking No. 83-14 (48 FR 46250; October 11, 1983). This Notice proposed to establish additional flammability requirements for seat cushions used in transport category aircraft certificated under Part 25 and Part 29 of the Federal Aviation Regulations (FAR) and to require that the cushions in most transport category airplanes operating under Part 121 comply with these new requirements 3 years after the effective date of the amendments.

The Notice responded to certain findings and a recommendation of the Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee and was based on research and development carried out by the Federal Aviation Administration (FAA) Technical Center and the Ames Research Center of the National Aeronautics and Space Administration.

The SAFER Advisory Committee was established in June 1978 by the FAA as a result of information from public hearings on aircraft fire safety. The FAA directed the Committee to "examine the factors affecting the ability of the aircraft cabin occupant to survive in the post-crash environment and the range of solutions available." The Committee consisted of 24 representatives of a wide range of aviation and general public interests. Technical support groups included approximately 150 of the world's top experts in fire research, accident investigation, materials development, and related fields. At the conclusion of its investigation into cabin materials technology, the Committee issued findings and formal recommendations pertaining to long-range research, design, testing, and the problems of smoke and toxic gas emission. One recommendation was that the fire blocking layer concept be developed for aircraft seat cushions as a means of retarding flame spread. The FAA concurred in this recommendation and carried out the research and development necessary for implementation of the concept.

As a result of regulatory amendments adopted in 1972, aircraft seat cushions are typically constructed of fire-retardant polyurethane foam and upholstery covering, all of which must presently pass the Bunsen burner test prescribed in § 25.853 of the FAR. In a prolonged full-scale cabin fire condition, however, severe thermal radiation can break down the outer upholstery covering and penetrate into the relatively large fuel mass of the polyurethane foam core. This causes the core to become involved in the fire, spreading flame and producing potentially lethal smoke, combustible gases, and toxic gases. The results of accident investigations and experimental fire tests conducted by the FAA have demonstrated that this involvement of foam cushion material is a dominant factor in the spread of cabin fire. To counter this, fire retardant performance standards for seat cushions based on the level of protection that can be achieved by the fire blocking layer concept were proposed in Notice 83-14.

The fire blocking layer concept involves the use of a thin layer of highly fire-resistant material to completely encapsulate and protect the larger mass of foam core seat cushion material from involvement in the cabin fire. This layer of fire-resistant material delays the onset of ignition and retards the involvement of the core in the fire.

The initial phase of the FAA research program for fire blocking layers consisted of a series of instrumented controlled environment cabin fire tests which confirmed the efficacy and practicality of fire blocking layers for aircraft seat cushions.

The subsequent phase of the program developed the test for evaluation and certification of cushions, using an adaptation of the type of 2 gallon/hour kerosene burner which is currently in standard use throughout industry as a test for metallic tubing assemblies and components. This test subjects the cushion test specimen to temperature and heat typical of full-scale cabin fire and is far more realistic and severe than the Bunsen burner test currently required in Part 25 for cushion materials.

Notice 83-14 proposed the detailed procedures of the kerosene burner test developed by the FAA. The proposed test would subject seat bottom and seat back cushion specimens to a 2-minute burner flame impingement. The proposed criteria for acceptance were based, in part, on the percentage weight loss of the cushion specimen during the test. While the proposal was based on the performance attained by fire blocking construction, the proposal would not require that seat cushions be constructed in that way. Rather, it proposed objective standards of performance for seat cushions so that if other or improved means of accomplishing the fire safety objective are developed, they can be used without a need for regulatory amendment. The Notice proposed to incorporate the new cushion flammability requirements as additions to the type certification standards for both transport category airplanes and transport category rotorcraft since the flammability requirements for these two categories of aircraft are identical. The Notice also proposed that 3 years from the effective date of the final regulation, seat cushions in airplanes type certificated after January 1, 1958, and operated under Part 121 meet the new requirements.

PUBLIC PARTICIPATION

These amendments are based on Notice 83-14. All interested parties have been given an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented. Except for the changes discussed below, these amendments and the reasons for their adoption are the same as those stated in Notice 83-14.

DISCUSSION OF COMMENTS

Forty-two comments were received in response to Notice 83-14, representing the views of aircraft and equipment manufacturers, aircraft operators, material producers and testing laboratories, aircraft crew organizations, U.S. and foreign government organizations, and consumer interests. The comments strongly support the objective of reducing the fire potential of seat cushion materials.

Several commenters believe the new cushion requirements should set limits on smoke and toxic gas emission. One commenter suggests using the National Bureau of Standards (NBS) smoke density chamber for this.

The FAA recognizes that reduction in smoke and toxic gas emission is an important issue in fire safety. Notice 83-14 explains that the new cushions will greatly reduce emissions by virtue of their reduced heat and flame spread potential. This has been proven by full-scale cabin fire tests. However, addressing the emissions issue in quantitative terms and setting limits on emissions based on a defined test procedure are beyond the scope of Notice 83-14. The NBS chamber mentioned by one commenter is a small-scale laboratory test which is not suitable for testing large cushion assemblies.

Several commenters contend the requirements should not apply to relatively small transport category airplanes such as executive airplanes and airplanes seating less than 44 passengers. Several of these commenters contend the basis for the justification for the requirements is the 40 seconds which can be gained in usable evacuation time through use of improved cushions to delay fire spread. They say while this gain might apply to larger aircraft, it cannot be realized in the smaller aircraft which generally have short evacuation times. Other commenters recommend extending the requirements to airplanes certificated under FAR Part 23 and those operated under FAR Part 135.

The FAA does not agree that benefits of the new requirements will be realized only in larger aircraft. The new requirements will greatly improve the fire safety of those furnishings which make up a major part of the cabin by reducing the potential for ignition and occurrence of fire and by inhibiting flame spread and smoke and toxic gas emission in the event fire does occur. Ignition, flame spread, smoke, and toxic gases are all potential hazards in inflight fires as well as in those post-crash fires involving emergency evacuation. Although the potential gain in evacuation time is more pronounced in larger aircraft, the new requirements will significantly benefit smaller aircraft as well. Notice 83-14 explains that the FAA is considering the need to propose similar requirements for small airplanes and rotorcraft used in Part 135 operations. Regulatory action for this would be the subject of a separate notice if found to be appropriate.

Several commenters contend the requirements should not apply to flight crewmember seats and flight attendant seats. These commenters point out that seat comfort has a significant influence on flight crewmember performance and efficiency and that there is the possibility fire blocking layers could compromise comfort on flights of long duration. They point out that the risk of fire involvement of flight crewmember seats is low because the seats are isolated from passengers and fuel, located near a fire extinguisher, and occupied at all times by personnel trained in fire prevention and control. One commenter points out that cushions of a flight attendant seat usually are thin and that the added thickness and weight of a fire blocking layer might interfere with the seat-retract mechanism.

The FAA agrees with the commenters on the issue of flight crewmember seats. Since inservice evaluation of fire blocking materials has not been completed, and those materials with optimum comfort properties have not been identified, it would be premature at this time to require the retrofit of seats the comfort of which might affect performance of the flight crewmembers. Since flight attendants do not usually remain in their seats for the duration of the flight, flight attendant seats are not considered as critical as flight crewmember seats from the standpoint of comfort and are not excluded from the requirements. There are several commercially available fire blocking materials which are thin and lightweight. These should have no effect on seat-retract mechanisms. The rule, as adopted, excludes flight crewmember seats from the requirements but does not exclude flight attendant seats.

Several commenters contend the 3-year compliance period proposed in § 121.312(b) should be extended to allow operators sufficient time to handle technical and logistical problems and to account for longer cushion life spans which they say exceed 3 years in many cases. The commenters contend the fire blocking requirements involve essentially a new technology and untested materials and that the proposed 3-year period does not allow sufficient time for cushion development, inservice testing, certification, production, and installation. They contend the added cost of an accelerated 3-year compliance period would be significant.

The FAA does not agree the compliance period should be extended. The FAA closely monitors industry progress and, while recognizing the concerns of the commenters, has not found any forseeable technical problem to suggest that retrofit cannot be accomplished smoothly within 3 years. Although the 3-year period was taken as the life span of a typical cushion, as explained in Notice 83-14, the longer life spans of some cushions mentioned by commenters would have no adverse impact on the regulatory action since the addition of fire blocking layers does not necessarily result in discarding cushions.

Several commenters contend the 3-year compliance period proposed in § 121.312(b) is too long and that fleet retrofit should be completed in a much shorter time. They contend the safety benefits of a shorter compliance time would exceed costs and that this justifies the faster retrofit. Several commenters recommend that all newly manufactured airplanes comply with the requirements within 1 year.

The FAA generally recognizes that benefits from safety improvements are maximized the sooner required retrofits are completed. However, as pointed out by several commenters, the subject regulatory action involves a new technology, and there must be sufficient lead time in the compliance period to enable all parties affected to attain reasonable proficiency, develop design alternatives, produce finished articles, and phase in installations. Fire blocking technology entails new test equipment and criteria and advanced state-of-the-art materials, many of which have not been service tested. The FAA believes a substantial reduction in the compliance period recommended by commenters would be impractical. The recommendation that newly manufactured airplanes comply within 1 year will effectively be achieved since, as a matter of practice, seat and aircraft manufacturers would meet the operational rules which govern their market. It is highly unlikely that manufacturers would produce noncomplying seat cushions after 1 year has passed, knowing the cushions would require retrofit in less than 2 years. It is equally unlikely that older aircraft being refurbished would be refurbished with noncomplying seat cushions, knowing that they would need to be replaced before the end of their normal useful life. These commercial considerations will cause manufacturers and operators who are refurbishing older aircraft to introduce seat cushions with fire blocking layers (or other equivalent means of fire protection) soon after the effective date of this rule. The 3-year compliance period is adopted as proposed.

Several commenters express concern that the addition of a fire blocking layer to a seat cushion approved under Technical Standard Order (TSO) C72b for flotation devices or TSO–C39a for seats might constitute a major modification of the cushion which could invalidate the TSO approvals.

The FAA has conducted cyclical flotation tests of several fire blocked cushions to determine the effect fire blocking layers might have on the buoyancy of cushions. The typical lightweight, highly fire-resistant materials being used as a fire blocker should have negligible effect on buoyancy. The use of heavy blocking material might reduce buoyancy to the extent which could require requalification under TSO–C72b. Provided the layer does not significantly reduce buoyancy or interfere with grasp straps, markings, or other flotation device features and the cushion foam core is not altered, the addition of fire blocking material is considered a minor modification and does not affect approval under TSO–C72b. Since the fire blocking layer requirements are additional to the requirements of § 25.853 and are in no way expected to affect seat cushions' eligibility to meet the standards of TSO–C39a and be so marked, approval under TSO–C39a is not affected.

Several commenters contend cushions which meet the new flammability requirements should not be required to meet § 25.853(b) as this would be redundant. Commenters contend also that if fire blocking layer material is required to meet § 25.853(b), it should be tested separately and not as part of a cushion assembly.

The FAA believes the new flammability requirements based on fire blocking performance and the requirements of § 25.853(b) are both necessary. Notice 83–14 explains that fire blocking delays, but does not prevent, ignition of cushion foam material and its involvement in cabin fire. The fire resistance required by § 25.853(b) is necessary in the event fire does penetrate the cushion. Under § 25.853(b), fire blocking material would be considered as upholstery in general and would be tested separately if it is not bonded or permanently affixed to the cushion foam. In view of the sound experience which backs up § 25.853(b), highly fire-resistant fire blocking materials should have no difficulty qualifying, whether tested separately or as part of a cushion assembly.

Several commenters contend the proposed requirements of § 25.853(c) and Appendix F, as written, are inflexible and would require an unnecessary amount of testing with the full-scale oil burner apparatus. Commenters point out there are numerous variations in color, weight, blend, texture, and other properties of cushion dress covering which have a negligible effect on fire safety. The commenters contend that once a cushion assembly is qualified by the oil burner test, minor changes in dress covering should be allowed without requalification by full scale testing.

The FAA agrees with the commenters that once a cushion is qualified by full-scale oil burner tests, additional tests are not necessary for minor changes in dress covering provided the replacement covering is similar to the original covering in fire resistance. The FAA recognizes that as experience is gained in the testing of various fire blocking materials and material combinations, the purposes served by full-scale testing and the situations which warrant it will become clearly focused. Therefore, paragraph (a) (3) of Part II of Appendix F is revised to allow that for a cushion which has been qualified by the oil burner test, the dress covering of that cushion may be replaced with a similar dress covering if the burn length of the replacement covering, as determined by the test specified in § 25.853(b), does not exceed the burn length of the original covering.

Several commenters contend the oil burner test is impractical for aircraft certification and that there should be provisions for testing small-scale laboratory specimens with smaller equipment such as the Meker gas burner, the Ohio State University Heat Release Chamber, or a radiant panel type test. Several commenters are concerned that the oil burner test is not suitable for quality control testing.

The FAA does not agree the oil burner test is impractical or should be replaced by some other test. It is intended as a design qualification test to substantiate the performance of an assembled product. The test subjects specimens to temperature and heat flux typical of cabin fire, as determined by full-scale cabin fire tests. For seat cushions, as for other aircraft components and assemblies, the required quality level of constituent materials is assured by use of small-scale tests or other assay methods selected by the manufacturer for the particular materials in question. The FAA does believe that eventually other tests may be developed which could be used for the qualification of cushions. While the commenters do not substantiate the validity or equivalency of another test at this time, the FAA believes this option should be left open to encourage future developments. Accordingly, § 25.853(c) and § 29.853(b) are specifically revised to allow a finding of equivalency.

Several commenters contend the ten percent weight loss limit is not a realistic measure of a cushion's resistance to fire and is not an appropriate criterion for acceptance. The commenters suggest using an absolute weight loss of around one-half pound per specimen. One commenter suggests using a rate of weight loss, although no specific rate is suggested. Several commenters contend that under the 10 percent criterion, an adequate supply of fire blocking materials will not be available to meet airline needs.

The FAA believes the 10 percent weight loss criterion is appropriate. The FAA has tested over 300 candidate fire blocking materials, of which over 100 passed the 10 percent criterion. The use of absolute weight loss in lieu of percent weight loss as the criterion for these materials had an insignificant effect on the overall pass/fail results. Percent weight loss normalizes test results according to specimen weight and affords a safeguard against the use of materials which might have a lower resistance to fire in combination with a lower weight. There is no indication a rate of weight loss as suggested by one commenter is more appropriate than percent weight loss. Rate of weight loss alone in this case would not provide a relevant indication of fire resistance unless related to time. The 10 percent criterion related to test duration which, as adopted, does not exceed 7 minutes. In view of the FAA materials tests and industry's progress in implementing the fire blocking concept, the FAA believes there is an adequate supply of materials to meet airline needs.

Several commenters contend the dimensionally standard specimens specified in Appendix F are not a realistic representation of cushions with complex curvatures and unique shapes. The commenters recommend testing actual cushions.

The FAA believes only dimensionally standard specimens should be used in the subject test to ensure a consistent baseline for comparison of cushion fire blocking performance. The test measures the effectiveness of material, or materials in combination, in delaying involvement of cushion foam in fire. For this, standard specimens of the materials are needed. The FAA evaluated the testing of nonstandard cushion shapes and found this can produce results unsuitable for the comparison of materials.

One commenter contends the requirements do not make clear if the seat bottom and seat back cushions must be constructed of identical fire blocking materials or may have different materials and different levels of fire blocking performance. This is a critical consideration since the test is more severe to the seat bottom specimen than the back specimen.

The requirements do not intend that materials in the back cushion necessarily be the same as those in the bottom cushion since material selection might be governed by comfort, durability, and other factors pertinent to the particular cushion. However, the requirements do intend that the materials in both the bottom and the back cushions be able to satisfactorily withstand the flame impingement of the test burner since in an actual cabin fire, flame impingement might be equally severe to both cushions. To clarify this intent, paragraph (a) (3) of Part II of Appendix F is revised to require that if different material configurations are used in the bottom and back cushions, each configuration must be tested as a complete specimen set.

Several commenters point out that the back sides of many seat back cushions are bonded to metal which effectively provides blocking layer protection. The commenters question whether in such cases the back side of the cushion must be enclosed by the same fire blocking material used to enclose the other sides.

The rule does not require the same blocking layer material be used to enclose all sides of a cushion, nor does it preclude the use of metal blocking layers. As adopted, it requires that the cushion meet the prescribed test requirements or equivalent. Seat structure in combination with some other material would be an acceptable combination of fire blocking materials, provided adequate performance of the combination is substantiated.

Numerous comments were submitted regarding the details of the proposed new test criteria of Appendix F. As a result, there are many revisions in the criteria, most of which are simple refinements to increase test repeatability. The most significant revisions are in section (a), Criteria for Acceptance, and these have only a minor effect on the performance level required of cushion specimens. Paragraph (a) (2) is revised to delete the requirement for venting internal cushion pressure. This requirement is not necessary since aircraft cushions inherently are self-venting by construction to accommodate cabin altitude changes. Paragraph (a) (4) is clarified by changing the term "flame spread" to the term "burn length," as currently used in Appendix F and by specification of a maximum permissible burn length based on specimen width. Also, paragraph (a) (4) is clarified regarding the number of specimens which must pass the test. Notice 83-14 proposed that one-half of the required three specimens, or two, pass. The rule as adopted specifies two out of three. Paragraph (a) (5) is revised to clarify the procedure for determining specimen weight after the test and to ensure that wide fluctuations in test results of marginal specimens do not unduly influence the pass/fail outcome of combined test results. The proposed requirement that there be no flaming accumulation of melted material beneath the test specimen is deleted. This was found to be impractical. Flaming material accumulation is as much a function of the test apparatus as of specimen material properties.

Numerous clarifications are made in sections (b) through (h), all of which have a negligible effect on test requirements. The method for determining ventilation rate of the test area is clarified. Tolerances for length, weight, temperature, and heat flux are specified, and additional descriptive information on equipment is provided. A requirement for conditioning the specimen at 55 percent relative humidity is specified. The type of fuel used for the test is specified as #2 Grade kerosene or equivalent. The time and means are specified for terminating the test for those specimens which do not self-extinguish.

REGULATORY EVALUATION

This amendment is expected to provide a net benefit to society, as likely benefits are expected to exceed likely costs. This evaluation relies heavily on information developed in a study done by the National Bureau of Standards (NBS), Center for Fire Research, entitled *Decision Analysis Model for Passenger-Aircraft Fire Safety With Application to Fire-Blocking of Seats,* published in March 1984. A copy of this study is available in the docket of this rulemaking action.

The NBS study reviewed an accident data base which included all world aircraft accidents where fire was a factor in fatalities, as well as major aircraft hull property damage incidents where a fire blocking seat interior might have lessened or eliminated property loss. The NBS study report lists all of these accidents, as well as the rationale for estimating the effectiveness of fire blocking layers in saving lives and lessening property damage.

The benefit effectiveness of fire blocking layers is basically a function of the increased time that is made available for aircraft evacuation, as a result of fire-blocking layers. This time is varied, ranging between 20 seconds and 60 seconds, in the NBS study. Table 1 below summarizes three basic values for fire-blocking benefits, based on assumptions of increased evacuation time and different levels of property damage. The only adjustment to the NBS study data is the use of a value of life of $650,000 compared to the $500,000 value in the NBS study. The higher number is used in FAA evaluations.

Fire Blocking Seat Alternatives
Annualized Benefit Summary
(Values in Millions of 1983 Dollars)

Additional Evacuation Time	*High*	*Middle*	*Low*
20 seconds	16.9 lives $ 3.87 damage $14.85 total	10.8 lives $2.21 damage $9.23 total	4.4 lives $1.76 damage $4.60 total
43 seconds	20.1 lives $ 3.87 damage $16.92 total	13.6 lives $ 2.21 damage $11.05 total	4.7 lives $1.76 damage $4.81 total
60 seconds	22.3 lives $ 3.87 damage $18.37 total	13.6 lives $ 2.21 damage $11.05 total	4.7 lives $1.76 damage $4.81 total

Note: Lives saved are valued at $650,000 per life.

Source: NBS study p.28 (except as per note).

For purposes of this evaluation, we will concentrate on the middle and high benefit range and limit analysis to the 20- and 43-second added evacuation time summaries. In this approach, we eliminate the extremes of very long evacuation times and very low benefit rates.

The NBS study estimated the costs of fire blocking seat alternatives much as the NASA study cited in FAA's preliminary regulatory evaluation did. The important elements of incremental cost are the incremental costs of refurbishing seats with seat blocking materials and the operating cost of carrying added weight around in the aircraft.

The following table summarized the high, middle, and low cost estimates of the incremental cost of material and installation for three blocking alternatives. The first is Norfab, a weave of 25 percent Nomex, 70 percent Kevlar, and 5 percent Kynol, aluminized on one side. The second is a loosely woven fiberglass scrim and a lightweight fiberglass paper bonded with a fire retardant adhesive. The third is 3/16″ Neoprene foam, bonded to urethane. The manufacturing costs are based on estimates provided by two seat manufacturers.

Incremental Cost of Fire Blocking Layers for U.S. Fleet
(Materials, Installation and Operating Costs)
(Data Are in Millions of 1983 Dollars)

Fire Block Alternative	*High*	*Middle*	*Low*
Norfab—Materials & Installation	$16.56	$11.83	$ 9.75
Operating Cost	9.93	9.93	9.93
Total Cost	$26.49	$21.76	$19.68
Fiberglass—Materials & Installation	$11.17	$ 6.68	$ 4.81
Operating Cost	2.92	2.92	2.92
Total Cost	14.09	$ 9.60	$ 7.73
Neoprene—Materials & Installation	$16.95	$ 9.29	$ 5.40
Operating Cost	19.49	19.49	19.49
Total Cost	$36.44	$28.78	$24.89

Source: Tables G-10 and 6 of NBS study.

The results of the NBS study indicate that there are fire blocking alternatives for which likely benefits clearly exceed likely costs. The fiberglass fabric alternative has a benefit/cost ratio greater than one except in those instances where comparisons use low benefits or high costs and middle benefit. Comparing middle costs with middle benefits, the benefit/cost ratio is 1.15.

There is some uncertainty about the predicted ultimate costs and benefits of the fire blocking rule which is adopted by this amendment. The major questions result from the uncertainties as to which technically feasible solutions will be practical. Several different solutions are being tried by industry, each of which appears promising. The optimum solutions will be known only after having fire blocking alternatives put into widescale utilization and testing with the airlines. On balance, however, FAA believes that this evaluation and the NBS study show that the amendment will create a net benefit to society.

It is expected that the airline supplies and materials industries will work with the airlines to develop a relatively inexpensive, lightweight fire blocking material. Even if practical problems are encountered with a fiberglass material, these problems will likely be solved, or alternatives will likely be developed which have weight and expense factors similar to fiberglass fabrics.

Regulatory Flexibility Act Determination

A final Regulatory Flexibility Analysis was conducted in compliance with Section 604(a) of the Regulatory Flexibility Act. The conclusion in the initial regulatory evaluation, that the rule may cause a significant economic impact on a substantial number of small entities, is not altered by the present evaluation.

There were no public comments in response to the initial regulatory flexibility analysis, and there are no alternatives which lessen the impact on small entities while providing all members of the traveling public with an equal level of protection.

Paperwork Reduction Act

Information collection requirements in this regulation (Part 25, Appendix F) have been approved by the Office of Management and Budget under the provisions of the Paperwork Reduction Act of 1980 (P.L. 96-511) and have been assigned OMB Control number 2120-0018.

Conclusion

Under the terms of the Regulatory Flexibility Act (the Act), the FAA has reviewed this amendment to determine the impact it might have on small entities.

Since the estimated impact on the small unscheduled air carriers could be approximately $9,000 per year, it has been determined that this rule may have a significant economic impact on a substantial number of small entities, such as small air carriers operating under Part 121. As required by the Act, the FAA has completed a regulatory flexibility analysis as part of the regulatory evaluation. A copy of the analysis/evaluation is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

The Act also requires that when there is a significant impact on small entities the agency must consider alternatives in the rulemaking process. In the case of flammability requirements, the alternatives are limited in number. One alternative would be to lessen the impact on small entities by making the more stringent requirements apply only to the larger air carriers or by allowing the smaller entities a longer period to come into compliance. These alternatives were rejected because of the importance of passenger safety, whether traveling on a large, scheduled airline or on a smaller, unscheduled airline. As alternative approaches, the FAA considered both regulations that would specify the only materials and construction processes permitted to be used and regulations that set performance standards to be met. The FAA has proposed performance standards to permit those operating under Part 121 the opportunity to choose and install the most economical materials and processes capable of meeting the flammability performance standards.

This rule is not likely to result in an annual effect on the economy of $100 million or more, or a major increase in costs for consumers; industry; or Federal, State, or local government agencies. In addition, this rule would have little or no impact on trade opportunities for United States firms doing business overseas or for foreign firms doing business in the United States. Accordingly, it has been determined that this is not a major regulation under Executive Order 12291. In addition, the FAA has determined that this action is significant under Department of Transportation Regulatory Policy and Procedures (44 FR 11034; February 26, 1979).

ADOPTION OF THE AMENDMENT

Accordingly, Parts 25, 29, and 121 of the Federal Aviation Regulations (14 CFR Parts 25, 29, and 121) are amended effective November 26, 1984.

(Sections 313, 314, and 601 through 610, Federal Aviation Act of 1958, as amended (49 U.S.C. 1354, 1355, and 1421 through 1430); 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983)).

Amendment 25-60

Fire Protection Requirements for Cargo or Baggage Compartments

Adopted: May 9, 1986 **Effective: June 16, 1986**

(Published in 51 FR 18236, May 16, 1986)

SUMMARY: This amendment upgrades the fire safety standards for cargo or baggage compartments in transport category airplanes by establishing new fire test criteria and by limiting the volume of Class D compartments. This amendment is the result of research and fire testing and is intended to increase fire safety.

FOR FURTHER INFORMATION CONTACT: Gary L. Killion, Manager, Regulations Branch (ANM-112), Transport Standards Staff, Aircraft Certification Division, FAA, Northwest Mountain Region, 17900 Pacific Highway South, C-68966, Seattle, Washington 98168; telephone (206) 431-2112.

SUPPLEMENTARY INFORMATION:

Background

This amendment is based on Notice of Proposed Rulemaking (NPRM) No. 84-11, which was published in the Federal Register on August 8, 1984 (49 FR 31830). The Notice proposed to upgrade the fire safety standards for cargo or baggage compartments in transport category airplanes by establishing new fire test criteria and by limiting the volume of Class D compartments.

As discussed in the Notice, there are five classes of cargo compartments (Class A, B, C, D, and E) in the existing Part 25 regulatory classification system. The classification of compartments is based primarily on the ease of access and the capability of the compartment to contain a fire. With the exception of the Class A compartment, all categories of cargo compartments are required to have liners in order to protect the structural integrity of the airplane from the effects of fire.

The FAA conducted a series of tests at its Technical Center to investigate the capability of three typical liner materials to resist flame penetration under conditions representative of actual cargo or baggage compartment fires. The tests were conducted in simulated Class C and D compartments with bulk-loaded baggage typical of that found in actual service. In conjunction with these tests, the FAA developed a method of testing liner materials utilizing a 2 gallons-per-hour kerosene burner. The materials—fiberglass, Keylar and Nomex—comprise the primary liner materials currently used lin domestic jet transport airplanes.

As a result of these full-scale tests, it was found that a fire could rapidly burn through Nomex or Kevlar under representative conditions. In addition to the fire hazards associated with the initial flame penetration, further suppression of the oxygen in compartments would be hindered. This, in turn, could result in a fire of increased intensity. It was therefore concluded that improved standards are warranted for the sidewall and ceiling liner panels of all classes of cargo or baggage compartments that depend on liners for fire control. Considering probable flame path, the FAA determined that it is not necessary for the materials used for bottom liner panels to meet these improved standards.

The full-scale tests conducted at the FAA Technical Center also showed that a limitation on the volume of Class D compartments is warranted. These tests indicated that the intensity of a fire in a Class D compartment is dependent on compartment volume as well as the sum of compartment volume and the volume of leadage from the compartment in a given period of time. In this regard, it was found that the intensity of a fire in a larger Class D compartment is much greater due to the total amount of oxygen available in compartments larger than approximately 1,000 cubic feet and is, therefore, beyond the capability of the liner to resist flame penetration. Accordingly, the volume of a Class D compartment would be limited to a maximum of 1,000 cubic feet.

The comment period for this Notice originally closed on October 8, 1984. It was reopened, as announced in Notice 84-11A (49 FR 40041; October 12, 1984), because of requests received from persons desiring more time in which to study the proposal and prepare their comments. The comment period was further reopened, as announced in Notice 84-11B (50 FR 13226; April 3, 1985), in light of requests received after further tests were conducted by the FAA at its Technical Center. One commenter requested that the FAA reopen the comment period for an additional period; however, the reason given was not considered sufficient to warrant such action. Although the comment period closed on June 3, 1985, late comments have been considered in accordance with 14 CFR 11.47(a). All interested parties have thus been given ample opportunity to participate in the making of this final rule, and due consideration has been given to all matters presented. Except for the changes discussed below, this final rule and the reasons for its adoption are the same as those stated in Notice 84-11.

Discussion of Comments

The numerous comments received in response to Notice 84-11 represent the views of airplane and equipment manufacturers, airplane operators, material producers and testing laboratories, airplane crew organizations, U.S. and foreign government organizations, and consumer groups. The vast majority of commenters endorse the intent of the proposals of Notice 84-11, although some suggest modifications to the proposed requirements. The following FAA responses to comments are discussed according to the subject matter of the comment.

One commenter believes the justification for the proposed standards to be deficient in analysis. In this regard, the commenter states that the basis for the proposed rule was a catastrophic fire which occured on a Lockheed L-1011 airplane and that the standards are a reaction to a preconceived notion that Kevlar and Nomex are less desirable than fiberglass since the proposed test methods do not relate to an actual fire scenario. The commenter contends that there is nothing in the analysis to indicate that the results of the L-1011 accident would have been prevented if fiberglass liners had been installed.

The proposed standards are not based on a scenario derived from an analysis of the L-1011 accident, but rather are based on full-scale testing that was conducted with simulated Class C and D compartments using bulk-loaded baggage. The full-scale tests showed that fiberglass, as typically used in cargo or baggage compartments, is superior to Kevlar or Nomex from a flame penetration standpoint. The more significant result of these tests is, however, the fact that existing standards for liner materials do not provide adequate protection from a typical cargo or baggage compartment fire. In this regard, it must be noted that liners constructed of Kevlar or Nomex, as well as those of fiberglass, meet the current standards. Because it would be impractical to conduct a full-scale test to qualify each type of material, the FAA developed test methods that would provide results comparable to those of a full-scale test from a materials qualification standpoint. As a result of this correlation, the proposed test methods do, in fact, relate to an actual fire scenario. As explained in Notice 84-11, the L-1011 accident cited by the commenter was *assumed* to have resulted from a fire in the cargo or baggage compartment for regulatory analysis purposes. The analysis notes that the specific cause of the fire is the subject of consideration dispute.

Several commenters present views supporting or opposing application of the proposed standards to airplanes already in service. Because such action would be beyond the scope of the Notice, the comments are not considered relevant to this rulemaking. The FAA is, however, considering additional rulemaking that will address this issue.

One commenter contends that, although reinforced with fiberglass and using state-of-the-art resins, almost all ceiling liners and some sidewall liners that are used in the current jet transport fleet do not meet one or more of the proposed requirements in that notice. The commenter also contends that materials which simultaneously satisfy the functional requirements for ceiling and sidewall liners, as well as the proposed fire safety standards, are not available. These contentions are not supported by the testing conducted. As noted in FAA Technical Note DOT/FAA/CT-TN85/11, An Evaluation of the Burn-Through Resistance of Cargo Lining Materials, dated April 1985, there are number of suitable liner materials that meet the standards and are available. A copy of this technical note has been placed in the Rules Docket.

One commenter contends that additional FAA and industry developmental work is clearly required prior to issuance of regulatory material to establish test apparatus, procedures, and evaluation criteria that will accomplish the intent of the proposed rule. The FAA does not agree. Testing has shown that the proposed standards do realistically discriminate between acceptable and unacceptable liners, and any further development work would unnecessarily delay introduction of improved liners in service.

One commenter supports the Notice, but is concerned that the research and development testing did not account for the possible presence of hazardous materials in the cargo compartment. While any consideration of a regulation addressing the effects of hazardous materials would be beyond the scope of the notice, it is noted that standards concerning the carriage of hazardous materials are contained in Chapter I of Title 49, Code of Federal Regulations (CFR).

Although two commenters consider the proposed standards to be too stringent, these standards have been shown to be necessary by full-scale testing and achievable with currently available materials. One of these two commenters further states that smoke and toxicity should also be addressed. Such standards would be beyond the scope of the Notice and could not be considered at this time. It should be noted, however, that existing § 25.831 provides standards for crew and passenger compartment ventilation and evacuation of smoke. While there is evidence of the need for improved standards with respect to flame penetration, the FAA does not have evidence that the existing standards of § 25.831 do not provide adequate protection from smoke and toxicity. Standards for toxicity would be especially difficult to establish because there has not been sufficient research to adequately define acceptable levels of human tolerance to typical cargo or baggage compartment fire toxicants.

One commenter proposes the use of a "total flood" of extinguishing agent in lieu of improved standards for the liners. Similarly, another commenter believes the standards should give credit for an active fire extinguishing system by allowing the use of liners with less resistance to flame penetration than that proposed in the Notice. These concepts are considered inadequate because liners with less ability to resist flame penetration are likely to fail very quickly before the extinguishing agent is effective, allowing the extinguishing agent to escape and rendering the extinguishing system inoperative.

One commenter compares the proposed standards for cargo or baggage compartment liners with the guidance in Advisory Circular 20-107A, Composite Aircraft Structure, for composites that are required to be fire-resistant. The commenter believes that the proposed standards are too stringent when compared to the standards for composite materials, considering that a fire in a cargo or baggage compartment would be less severe (according to the commenter) due to the limited amount of oxygen available, The comparison of the proposed standards with the guidance for composite materials is not appropriate because the purposes differ. The proposed standards for cargo or baggage compartments are intended to safely contain a fire. The guidance for composite materials is, on the other hand, to ensure that the structural integrity of the materials will be maintained during exposure to a fire.

Two commenters believe that the rulemaking for improving fire safety in air carrier airplanes is proceeding faster than the fire safety technology. The FAA has determined that the technology exists for compliance with these new standards and that consequently the manufacturers can design liners for cargo and baggage compartments that meet the new standards.

Two commenters support the proposed standards for Class C and D compartments, but not for Class B or E compartments. A Class B compartment is typically the large cargo portion of the cabin in a combination passenger and cargo carrying airplance (frequently referred to as a "combi" airplane). A Class E compartment is the main cabin of an airplane used only for the carriage of cargo. Both Class B and E compartments may be dedicated solely to the carriage of cargo or may be convertible passenger or cargo compartments. (Airplanes with convertible compartments are frequently referred to as "quick change (QC)" airplanes.) The seats of QC airplanes are generally installed on pallets so that they can be removed rapidly for the carriage of cargo. The sidewalls, bulkheads and ceilings of the passenger interiors then serve as the liners of the cargo compartments. Like Class C compartments, Class B and E compartments are required to have smoke or fire detection systems to give warning at the pilot or flight engineer station. For fire extinguishment, Class B compartments are required to have sufficient accessibility to enable a crewmember to effectively reach any part of the compartment with the contents of a hand fire-extinguisher. Class E compartments must have means to shut off the ventilating airflow and to exclude hazardous quantities of smoke, flames or noxious gases from the flightcrew compartment. Class B and E compartments, therefore, do not depend on the integrity of the liner to retain the agent from a built-in extinguishing system, as in a Class C compartment, or to limit the supply of oxygen, as in a Class D compartment. Based on the lack of adverse service experience with Class B and E compartments to date, and the lack of full-scale test data that are directly applicable, the FAA concurs that the liners of these compartments need not meet the new standards. This does not preclude future rulemaking to require such liners to meet these standards if warranted by further service experience or tesing.

Several commenters have presented opposing views concerning Class D compartments. Some contend that the proposed 1,000 cubic feet limitation of the volume of a Class D compartment is too restrictive. One commenter suggests that the rate of ventilation and leakage for Class D compartments should be as low as practicable and should not exceed the following formula, which (according to the commenter) has been an acceptable means of compliance with the objective requirements of current § 25.857(d):

$$W = 2{,}000 - V$$

Where W = ventilation and leakage airflow in cu. ft. hr.

V = compartment volume in cu. ft.

One commenter further suggests that the burner heat flux density, flame temperature, and time of application, should be redefined to reflect conditions to be established by the FAA Technical Center by further testing for a Class D compartment that is greater than 1,000 cubic feet, but meets the above formula. As discussed in the Notice, the tests conducted at the FAA Technical Center indicated that the intensity of a fire in a Class D compartment is dependent on compartment volume as well as the sum of compartment volume and the volume of leakage in a given period of time. In this regard, it was found that the intensity of a fire in a larger Class D compartment is much greater due to the total amount of oxygen available in compartments larger than approximately 1,000 cubic feet, and beyond the capability of the liner to resist flame penetration. While the leakage rate is an important consideration, a low rate does not mitigate the need to limit the total volume of a Class D compartment ot 1,000 cubic feet. The more stringent standards that would be needed to safely contain a fire in a compartment greater than 1,000 cubic feet would be beyond the scope of the Notice.

Other commenters, in contrast, believe that Class D compartments should be eliminated altogether. One commenter is concerned that a fire may originate in a Class D compartment that is nearly empty, grow out of control due to the greater amount of oxygen available, and spread to an adjacent compartment that does have combustible cargo or baggage. This scenario is considered unrealistic because the compartment in which the fire originates is unlikely to contain enough combustible materials to sustain an intense fire for an extended period if it is nearly emplty. In this regard, the scenario presupposes, first, that the combination of compartment volume and leakage airflow and liner integrity are inadequate to safely suppress and contain the fire in the original compartment and, second, that the liner of the adjacent compartment is incapable of preventing burn-through in reverse. In light of the testing conducted, the proposed standards would make both suppositions unlikely. The same commenter is concerned that in-service damage to liners may allow additional leakage airflow and compromise the capability of the liner to suppress a fire. The FAA notes the commenter's concern and concurs that the use of improved materials will increase the capability of the liners to suppress fires only if the integrity of the liners is maintained in service. In this regard, the FAA is presently emphasizing to operators the importance of properly maintaining the liners in all cargo or baggage compartments that are required to have liners and has stepped up surveillance of airline maintenance of cargo compartment liners. The commenter is also concerned about the failure of a ventilation control valve in a Class D compartment which, the commenter alleges, was the cause of the previously discussed Lockheed L-1011 accident. As also noted previously, the cause of the fire involved in that accident is a matter of considerable dispute, and has not been attributed to such a failure.

One commenter supports the proposed limitation of the volume of a Class D compartment to 1,000 cubic feet but believes a specific limitation on leakage airflow should also be imposed. The FAA concurs that the leakage airflow rate is an important factor. Such leakage must be considered for compliance with the objective requirements of current § 25.857(d)(1). As these objective requirements would remain applicable, it is not considered necessary to establish a specific limitation on leakage airflow.

Two commenters recommend that the FAA require fire detection systems for Class D cargo compartments so that the flightcrews would be alerted to the existence of a fire. Another commenter recommends that all cargo compartments, except Class A and B, should be classified as Class C. Whie these recommendations are beyond the scope of the Notice, either is considered to be warranted. As discussed above, the full-scale and other fire tests have shown that Class D compartments provide an acceptable level of safety if liners meeting the new standards are used and the volume does not exceed 1,000 cubic feet. As discussed below, the present standards are considered to provide an acceptable level of safety for Class B and E compartments.

One commenter notes that standards for flammability of seat cushions have been adopted (Amendment 25-59; 49 FR 43188; October 26, 1984) since the time Notice 84-11 was issued and believes that many of the elements of the testing required for seats are also appropriate for liner testing. Although there are necessary differences due to the nature of tests, the FAA concurs that the test methods and procedures should be the same wherever possible. The adopted test procedures have been changed accordingly.

One commenter recommends that the burner heat flux density, flame temperature, and time of application should be redefined to reflect the conditions to be established for a Class C compartment with a properly operating fire detection and extinguishing system. Based on the full-scale tests conducted, the FAA considers that the proposed criteria do simulate the exposure conditions (including burner heat flux density, temperature, and duration) of a realistic cargo fire in a Class C compartment equipped with detectors that provide indication of a fire within one minute, as required by existing § 25.858. The proposed standards are, therefore, considered appropriate in this regard and have been adopted in this final rule.

Several commenters suggest test specimen sizes other than the proposed 16 x 25 inches. One commenter recommends the use of 16 x 24 inch specimens in order to reduce waste when specimens are cut from a standard 4 x 8 foot sheet. The FAA concurs with this recommendation and the requirement has been changed accordingly.

As proposed, ceiling and sidewall liners would have to meet the improved standards while floor panels would only have to meet the current standards. Two commenters believe that flooring should also meet the higher standards; however, their position is not supported by the results of the full-scale testing. Such tests have shown that fires tend to burn upward, and there is little or no involvement of flooring. The improved standards are, therefore, not warranted for flooring.

In lieu of the proposed test panel size and positioning, one commenter suggests the use of a 610 mm x 610 mm panel centered horizontally 203 mm above the flame. Alternate panel sizes and positioning could be used under the equivalent safety provisions of § 21.21(b)(1) of this chapter provided the tests yield the same results. The suggested change is, therefore, unnecessary. The same commenter believes that negative test results should not preclude the use of aluminum as liner material. The FAA does not concur because, for reasons stated earlier, the FAA considers the proposed standards to be the minimum required for safety. Testing conducted subsequent to Notice 84-11 has shown that aluminum sheet, in thicknesses typically used for liners, does not meet the proposed standards.

Several commenters express related concerns that the proposed rule would require only the basic panel material to be tested and that design features, such as joints, structural attachments, lamp units, lashing points and pressure relief panels, would be omitted. In this regard, one commenter contends that the proposed test seems to confuse two objectives: The need to demonstrate the ability of a material to resist flame penetration and the need to demonstrate fire containability of a "simulation" of the ceiling and sidewall. The commenter states that view A-A of Figure 1 of the Notice shows the edges of the panel held in a manner that is not representative and is not therefore a "simulation" that will test a design detail.

In response to the commenter's concerns, the term "liner," as used in § 25.855(a-1), includes any design features that would affect the capability of the liner to safely contain a fire. Such features would, therefore, have to be tested along with the basic panel material unless they have been previously found satisfactory. For example, joints that are constructed with fireproof fasteners and are not subject to gaps caused by distortion need not be tested. On the other hand, the test specimens would include joints constructed with nonfireproof fasteners or joints subject to distortion. Similarly, test specimens would include lamp lenses, if failure of the lenses would allow flames to pass; however, lamps need not be included in the test specimen if the lamp incorporates a fireproof body that would prevent passage of flames. The test acceptance criteria have been clarified in this regard. One commenter also contends that the apparatus sssumes that the sidewall will be vertical, which is not always the case. Tests have shown that results obtained with vertical panels are also representative of sidewalls that are inclined; therefore, the FAA considers the test apparatus to be appropriate in this regard.

One commenter suggests that it is unnecessary to test ceiling and sidewall panels simultaneously. The FAA concurs that it is not necessary to test ceiling and sidewall panels simultaneously; and it may, in some instances, be advantageous to test the panels separately. For example, material tested as a ceiling panel with a baffle installed to stimulate the missing side panel would be qualified for use as ceiling material with any otherwise qualified sidewall material. Furthermore, the material would also be qualified for use as sidewall material due to the test heat transfer characteristics. On the other hand, a material tested as a ceiling panel simultaneously with a sidewall panel would be qualified for use only with sidewalls of the material used in the sidewall test panel.

One commenter believes that the use of alternate burners should be allowed. The commenter notes that kerosene burners with improved adjustment and controlling devices are available and that gas-type burners could also be used. The proposed standards note that two particular burner models have been used in the past, but the standards do not specifically require us of those particualr models. Any burner that meets the proposed standards could, therefore, be used. Other burners, such as gas-type burners, could be used under the equivalent level jof safety provisions of § 21.21(b)(1) of this Chapter provided they are shown to give the same test results.

Two commenters believe that the test fixture should be revised to allow a baffle to be placed around the liner. The baffle would simulate a ceiling and thereby prevent the piloted ignition of combustion gases released by the test specimen. Such use of a baffle is not considered appropriate because combustible gases released from liner materials could reignite outside the compartment and contribute to the hazard in an actual cargo or baggage compartment fire. Futhermore, there are currently available materials constructed with resins that do not release such combustible gases.

The proposed burner test fuel is defined as "kerosene." One commenter believes that this term is too broad and notes that its use has led to problems in testing both cargo or baggage compartment liner materials and seat cushions. The FAA concurs and notes that the test fuel for the recently adopted seat cushion flammability standards (Amendment 25-29; 49 FR 43188; October 26, 1984) is defined as "#2 kerosene or equivalent." For consistency, the fuel for testing cargo or baggage compartment liners will also be defined as "#2 kerosene or equivalent."

The proposed burner cone is 12 inches wide at the exit. As equipment already in use incorporate burner cones that are 11 inches wide, one commenter recommends specifying that this dimension should be specified as 11.5 ± 0.5 inches in order to accommodate both sizes. It appears that such a variation in burner cone area would cause variations in burner heat output and inconsistencies in test results. Use of the 11-inch wide cone specified for the recently adopted seat flammability standards (Amendment 25-29; 49 FR 43188; October 26, 1984) would eliminate the need for two separate cones while still assuring consistency of test results. The test apparatus specified for these tests has been changed accordingly.

Two commenters recommend conditioning the test specimens to 50 ± 5 percent relative humidity prior to testing. The FAA concurs. In order to assure consistent test results, the test specimen criteria will include such conditioning.

One commenter notes that there are brief excursions below the minimum temperature on any one thermocouple due to the transient nature of a fire. The commenter suggests that these excursions can be as great as 100°F. and as frequent as several seconds apart. In order to accommodate a temperature measuring device that takes periodic instantaneous readings rather than a continuous reading, the commenter recommends using the average of temperature and heat flux over a representative exposure time, e.g. one minute, in lieu of the minimum values. In general, it appears that such averaging would not ensure the intended level of safety. A temperature measuring device of this nature could, however, be used under the "other equivalent methods" provisions of § 25.855 (a-1)(1) provided it is shown to provide test results equivalent to those that would be obtained with continuous reading devices.

One commenter suggests the proposed acceptance criteria that self-extinguishing time must be les than 15 seconds and that glow time must be less than 10 seconds are unnecessary. The FAA concurs that materials that meet the proposed burn-through criteria will inherently have satisfactory self-extinguishing and glow characteristics, and these criteria have been deleted.

Two commenters suggest increasing the measured limit 4 inches above a tested ceiling liner to more than 400°F. (One commenter specifically recommends 500°F.) Although the temperature measured at this point varies depending on the weave and resin of the material tested, tests have shown that many materials are capable of meeting the proposed limit. The proposed limit of 400°F. is, therefore, considered appropriate.

One commenter believes that the standards should be more precise as to what kind of heat energy shall be measured, i.e., heat radiation only or the total heat flux consisting of radiation and convection. The notice specifies total flux. To avoid possible confusion, a Foil Type Gardon Gage total heat flux calorimeter is specified.

One commenter recommends establishing the following tolerance for the thermocouple calibration temperature: a 1700°F. minimum temperature averaged over the seven termocouples with a maximum lower deviation for any one thermocouple of 100°F. The FAA concurs that the standards must allow a tolerance in this regard as a matter of practicality. The rule is changed accordingly.

One commenter suggests that the test time be measured to flame penetration *or* test completion. The FAA concurs that this change is needed to cover tests in which the test is successfully completed without any penetration. The rule is changed accordingly.

One commenter requests an additional requirement to record the flame time after removal of the flame source and the glow time. As noted earlier, these criteria are unnecessary for materials that meet the proposed burn-through criteria. This addition is, therefore, unwarranted.

Since the time Notice 84-11 was issued, existing Appendix F of Part 25 has been reidentified as Appendix F, Part I, and new standards for flammability of seat cushions have been added as Appendix F, Part II by Amendment 25-59; (49 FR 43188; October 26, 1984). The new standards for cargo or baggage compartments are, therefore, added as Appendix F, Part III. Other nonsubstantive conforming editorial changes, including that to § 25.853(b), have also been made. Furthermore, minor nonsubstantive changes have been made to the test procedures.

Regulatory Evaluation

I. *Cost Benefit Analysis.*

A. *Costs.*

The costs of the amended regulations included in this final rule will result primarily from the additional fuel consumed by the airplanes subject to the rule as a result of the slight increase in airplane weight necessary to comply with the new standards. The airplanes that would be affected are those newly designed transport category airplanes for which an application for type certificate is made on or after the efffective date of the final rule. The precise number of airplanes which will be affected cannot be accurately predicted because of the uncertainties in the number of future airplane designs and the number of airplanes of each design that will be produced. The estimated costs of this final rule have, therefore, been based upon average total costs for a typical type certificate issued, rather than overall costs for all future airplane types which may be certificated under the new standard. (This differs slightly from the methodology used in Notice 84-11, where fuel penalty costs were presented on an hourly basis.) Further, in developing the average total costs per type certificate issued, the FAA has estimated that a newly type certificated airplane will have a production run of approximately 1,000 airplanes, and that each airplane will have an average life of 60,000 hours, yielding a total of 60 million flight hours for all airplanes produced under a typical type certificate. Because both the costs of this rule, and the benefits of reduced exposure to the risk of a catastrophic cargo compartment fire, will be realized simultaneously during actual operation of the airplanes, the ratio of costs to benefits will remain unchanged regardless of the level of activity in any given year over the 40 to 50 year period during which airplanes produced under a typical certificate will remain in active service. Thus, comparisons can be made in the form of total costs and benefits for all airplanes produced under one type certificate, rather than in the form of discounted present values, which would necessitate making arbitrary assumptions about the rates of airplane production, activity, and attrition during each year of the 40 to 50 year period.

Of the materials which meet the more stringent flame penetration standards adopted in this final rule, fiberglass, is currently considered the most feasible material for use as sidewall or ceiling panels of cargo or baggage compartments. This material is somewhat heavier than Kevlar or Nomex, the other two liner materials currently used in transport category airplanes. According to data compiled by the FAA, Boeing achieved a weight savings of approximately 150 pounds in each Model 767 airplane by using Kevlar instead of fiberglass for the ceiling and sidewall panels. Because the Model 767 falls approximately in the middle of the size range of existing transport category airplanes, the FAA has assumed, for purposes of this analysis, that a typical affected transport category airplane would incur an average weight penalty of approximately 150 pounds as a result of the need to use fiberglass liner materials in lieu of lighter alternatives, such as Kevlar or Nomex. This, of course, is based on the further assumption that no new lightweight materials are developed which would meet the higher flame penetration standard.

Date compiled by the National Aeronautics and Space Administration (NASA) indicate that each additional pound of weight added to a transport category airplane results in an average additional fuel consumption of about 15 gallons per year per airplane, or an average of .006 gallons per hour based upon an average utilization rate of 2,500 hours per year per airplane. At the current jet fuel price of $.85 per gallon, and 1,000 airplanes flying a total of 60,000 lifetime hours each, the total additional fuel cost attributable to the heavier liner material will be approximately $46 million for each future type certificate that is issued. This cost will be incurred over a period of 40 to 50 years, and equates to about $46 thousand per airplane distributed over the lifetime of that airplane. Actual costs can be expected to be less than this estimate because of expected improvements in the fuel efficiency of new technology engines.

Cargo or baggage compartments larger than 1,000 cubic feet in volume may currently be designed as Class D compartments in lieu of Class C compartments with smoke or fire detection and fire extinguishment systems. Under the terms of this amendment, compartments of this size in affected airplanes would have to be designed as Class C compartments. The FAA estimates that an average weight penalty of 150 pounds per affected airplane would result from the installation of smoke or fire detection and extinguishment systems in the Class C compartments that, in the absence of the rule change, would have been designed as Class D compartments. This will result in an additional $46 million total weight penalty per type certificate for all airplanes built under type certificates which are also affected by this provision of the final rule.

Further, the cost of the smoke or fire detection and extinguishment systems must also be considered (this cost factor was erroneously omitted from the evaluation of Notice 84-11). The FAA estimates that system equipment, installation by the airframe manufacturer, and interest will add approximately $10,500 to the cost of each airplane purchased, yielding a total additional cost of $10.5 million per type certificate for the approximately 1,000 airplanes estimated to be built under a future type certificate. Although each individual airplane cost represents a capital expenditure, the total cost will be spread over the entire production run of an airplane model produced under a type certificate, and further annualized by the purchaser of each airplane produced. Consequently, these detection and extinguishment system costs will be incurred over a period of 20 to 30 years. They have, therefore, been presented in the form of total costs rather than in the form of discounted present values for the same reasons discussed previously with respect to fuel costs.

The total cost of the liner material weight penalty, detection and extinguishment system weight penalty, and detection and extinguishment system equipment is estimated to be $102 million per type certificate for those future designs which will be affected by both the amended Class D volume constraint and the new liner material standard. These total costs will be incurred over a period of 40 to 50 years, and equate to about $102 thousand per airplane distributed over the lifetime of that airplane. It must also be noted that relatively few existing transport airplanes have Class D compartments which are larger than 1,000 cubic feet in volume. There are currently only three airplane designs in domestic use with such compartments (the McDonnell Douglas Models DC-8 and DC-10, and the Lockheed Model L-1011. Therefore, assuming no major change in the size distribution of transport airplanes, a relatively small proportion of airplanes type certificated in the future is expected to be affected by the reduction in the maximum allowable volume of a Class D compartment.

Some commenters stated that, in its analysis, the FAA neglected to consider costs related to design features such as panel joints, lamp assemblies, pressure relief panels, structural attachments, etc. These costs, if any, are considered negligible. This final rule applies only to new airplane designs; therefore, there are no redesign costs involved. Furthermore, most of the components and design techniques which are currently in use will meet the new standards. For the few instances in which current components or techniques cannot be used, the designer can choose to use other equivalent components or techniques that will meet the new standards and are currently available.

B. *Benefits.*

The potential benefits of these rule changes are the avoided losses of life and property which would have resulted from those airplane fires that may be prevented by the provisions of the final rule. While a relatively minor benefit will result from the use of fiberglass, which is slightly less expensive to purchase than Nomex or Kevlar, this cost saving is overshadowed by the saving of the total cost of a new airplane or the benefits of accidents prevented over the lifetime of an airplane design. Qualifying these benefits is somewhat difficult because most transport category airplanes currently in service have liners constructed of fiberglass materials which already meet the new standards, and because relatively few have Class D compartments which are larger than 1,000 cubic feet in volume.

Because of the limited number of airplane models currently in service which do not meet the new standards, a Poisson distribution has been used to estimate the probability of preventing random cargo compartment fire accidents during the total service life of a newly designed transport category airplane which is type certificated in accordance with the new standards. This probability approach is somewhat different than the method used in Notice 84-11, in which a maximum possible accident rate was estimated.) The Poisson distribution provides a realistic model for predicting many random phenomena and frequently is used in safety analysis to estimate future accident risk. The Poisson distribution of potential catastrophic cargo compartment accidents provides a base line from which the potential benefits of the rule change can be measured. Because it is unlikely that the new liner standards or the Class D volume constraint can effectively prevent a catastrophic accident from developing in every possible fire scenario, a sensitivity analysis has been completed to compare the probable benefits which would result if the new standards were effective in 100 percent, 70 percent and 50 percent of the fire scenarios.

In order to develop the Poisson distribution for this analysis, it is necessary to determine the historical average rate of catastrophic cargo compartment fires. Of the three major transport category airplane models currently in service with liner materials that do not meet the new flame penetration standards, only one has been in service for an extended period of time. This is the Lockheed L-1011, which uses Nomex as the liner material in its cargo or baggage compartments. (The other two airplanes, Boeing Models 767 and 757, use Kevlar as the liner material, and each has been in service for only about three years.) Since the Model L-1011 entered service in 1972, it has experienced one catastrophic fire that was possibly related to the cargo compartment. The specific origin or cause of this fire is the subject of considerable dispute; however, for the limited purposes of this document, it will be assumed that the fire originated in the cargo compartment. Based on these assumptions, the limited service experience with the Model L-1011 suggests a mean rate of one catastrophic cargo compartment fire accident in the total service life of all airplanes built under a type certificate which does not require compliance with the new standards. This mean rate of one may be used to develop the Poisson distribution of the possibility of accidents which could be experienced by a future design which does not comply with the new liner material standards. The FAA believes that this is a conservative estimate of the mean accident rate because the current accumulated flight time of all Model L-1011 airplanes is far less than the 60 million hours of total flight time estimated in this analysis to be accumulated by all airplanes produced under a typical future type certificate.

Futher, the same mean accident rate of one has been used to estimate benefits for those future designs which will be affected by the Class D volume constraint as well as the new liner material standard. Although it stands to reason that a greater safety benefit will be realized for those airplanes for which both fire protection deficiencies (Class D volume and liner material) is corrected, there have been no actual cargo compartment fire accidents that have been attributed to the size of the Class D compartment. Nevertheless, the full-scale tests conducted at the FAA technical Center clearly indicated that the intensity of a fire in larger Class D compartments can become so great that the capability of the liner to resist flame penetration is exceeded. In the judgment of the FAA, a mean rate of one catastrophic cargo compartment accident is a reasonable compromise between the service history of existing noncompliant airplanes and the results of the laboratory tests. Therefore, this rate has been used to develop an order of magnitude estimate of the potential benefits which may be realized by those future airplane models affected by both of its new standards.

Applying the effectiveness coefficients of 100 percent, 70 percent, and 50 percent to the mean accident rate of one provides probability distributions, based upon each respective assumption about the effectiveness of the new standards, of the number of accidents which might be prevented for each future airplane design receiving a type certificate in compliance with the new standards.

The FAA estimates that the benefits which will be realized from avoiding a typical cargo compartment fire accident in the future will be the prevention of 110 passenger and crew fatalities (derived from FAA traffic data) and the loss of the airplane. Mid-size transport category airplanes which have recently received new type certificates and new designs currently under development are priced between $30 million and $60 million. The FAA, therefore, estimates that $20 million is a reasonable price for a typical used transport category airplane of the future and has used this value as the quantifiable benefit of avoiding the loss of an airplane for each accident prevented.

Based on the Poisson distribution and the alternative effectiveness assumptions discussed above, there is a 63 percent probability that one or more catastrophic cargo compartment fire accidents will be prevented, if the new standards are 100 percent effective, for each future airplane design issued a type certificate under the new standards. If the new standards are at least 70 percent effective, then the probability that one or more catastrophic accidents will be prevented for each type certificate is about 50 percent; and if the new standards are 50 percent effective, then there is a 40 percent probability that one or more accidents will be prevented for each type certificate. These potential benefit estimates must be compared to the 63 percent probability that, in the absence of these new standards, one or more catastrophic accidents will occur for each new type certificate that is issued which does not meet these standards.

C. *Comparison of Costs and Benefits.*

The FAA has estimated that the total cost per type certificate for the new liner standard, distributed over a 40 to 50 year period, will be about $46 million. The FAA expects that the majority of future airplane designs receiving new type certificates will be affected by the liner standard only. If one or more catastrophic accidents are prevented, then the loss of at least one airplane valued at $20 million will be prevented, at least 110 fatalities will be prevented, and the cost per fatality avoided will not be greater than $235 thousand. For those relatively few new aircraft designs which may be required to comply with both the amended liner material and the Class D compartment size standards, then the total costs increase to approximately $102 million per type certificate over a 50 year period. If one or more accidents are prevented, the same benefits as those expected for airplanes subject to only the liner standard will be realized, except that the maximum cost per fatality avoided will increase to approximately $748 thousand.

Based upon a conservative estimate of the historic accident rate, and a sensitivity analysis of the potential effectiveness of the new standards, there is about a 40 to 60 percent probability that one or more catastrophic cargo compartment fire accidents will be prevented for each new type certificate that is issued, and that very reasonable cost-benefit relationships will be achieved. This compares to about a 60 percent probability that one or more catastrophic fire accidents will occur for each noncompliant type certificate that is issued in the absence of these new standards.

II. *Regulatory Flexibility Act Determination.*

A final regulatory flexibility determination was conducted in compliance with the Regulatory Flexibility Act. The conclusion in the initial regulatory evaluation, that the rule will have no direct impact on small entities, is not altered by the present evaluation.

III. *International Trade Impact Analysis.*

The amendment will have little or no impact on trade for both U.S. firms doing business in foreign countries and foreign firms doing business in the U.S. In the U.S., foreign manufacturers will have to meet U.S. requirements, and thus they will gain no competitive advantage. In foreign countries, foreign manufacturers could have some minor cost advantage if the foreign country does not require the improved design standards, but because the cost will be negligible compared to the new airplane cost, there will be essentially no impact.

CONCLUSION: For the reasons discussed earlier in the preamble, the FAA has determined that this regulation is not considered to be major under Executive Order 12291. The FAA has determined that this action is significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, it has been determined under the criteria of the Regulatory Flexibility Act that this rule does not have a significant economic effect on a substantial number of small entities, since none would be affected. A regulatory evaluation, including a Regulatory Flexibility Determination and Trade Impact Assessment, has been prepared for this regulation and has been placed in the Rules Docket. A copy of this evaluation may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Adoption of the Amentment

Accordingly, Part 25 of the Federal Aviation Regulations (FAR), 14 CFR Part 25 is amended effective June 16, 1986.

Authority: 49 U.S.C. 1344 (1354(a), 1355 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

Amendment 25-61

Improved Flammability Standards for Materia's Used in the Interiors of Transport Category Airplane Cabins

Adopted: July 10, 1986 **Effective: August 20, 1986**

(Published in 51 FR 26206 July 21, 1986)

SUMMARY: These amendments upgrade the fire safety standards for cabin interior materials in transport category airplanes by: (1) Establishing new fire test criteria for type certification; (2) requiring that the cabin interiors of airplanes manufactured after a specified date and used in air carrier service comply with these new criteria; and (3) requiring that the cabin interiors of all other airplanes type certificated after January 1, 1958, and used in air carrier service, comply with these new criteria upon the first replacement of the cabin interior after a specified date. These amendments are the result of research and fire testing and are intended to increase airplane fire safety.

The FAA also requests additional comments on the final flammability criteria for possible refinement of either the test procedures or acceptance criteria.

ADDRESSES: Send comments to: Federal Aviation Administration, Office of the Chief Counsel, Attn: Rules Docket [AGC-204], Docket 24594, 800 Independence Avenue, SW., Washington, D.C. 20591.

The closing date for comments is January 21, 1987.

FOR FURTHER INFORMATION CONTACT: Gary L. Killion, Manager, Regulations Branch (ANM-112), Transport Standards Staff, Aircraft Certification Division, FAA, Northwest Mountain Region, 17900 Pacific Highway South, C-68966, Seattle, Washington, 98168; telephone (206) 431-2112.

SUPPLEMENTARY INFORMATION:

Background

These amendments are based on Notice of Proposed Rulemaking (NPRM) No. 85-10, which was published in the Federal Register on April 16, 1985 (50 FR 15038). The Notice proposed to upgrade the flammibility safety standards for materials used in the interiors of transport category airplane cabins.

As discussed in the Notice, the FAA established a committee in June of 1978, to examine the factors affecting the ability of the aircraft cabin occupant to survive in the post-crash environment and the range of solutions available. The Committee was composed of fire safety experts from the National Aeronautics and Space Administration, the aerospace industry, and the general public. Included in the recommendation of this committee, which was known as the Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee, were further research development in regard to cabin materials and prompt evaluation and implementation of a method using radiant heat for testing cabin materials. The FAA concurred and initiated the necessary research and development. The resulting research and development program, which was managed and conducted primarily at the FAA Technical Center in Atlantic City, New Jersey, was designed to study aircraft fire characteristics, develop practical test methods, and investigate the feasibility of the various new standards being considered at that time. Further study concerning toxicity was conducted at the FAA Civil Aeromedical Institute (CAMI) in Oklahoma City.

Among the tests conducted at the Technical Center were full-scale fire tests using the fuselage of a military C-133 configured to represent a wide-body jet transport. The test conditions simulated representative post-crash external fuel-fed fires. Numerous laboratory tests were also conducted to correlate possible material qualification test methods with the full scale tests. As a result of these tests, the Ohio State University (OSU) rate of heat release apparatus, as standardized by the American Society of Testing and Materials (ASTM), ASTM-E-906, was determined to be the most suitable for material qualifications. The OSU rate of heat relase apparatus employs radiant heat, which the SAFER Advisory Committee recommended because it is most representative of the post-crash fire environment. The ability of the test method to adequately discriminate acceptable from unacceptable materials was vertified using several generic materials. The generic materials covered a range of flammability characterictics and each was tested and ranked in the full-scale fire test facility. Sample materials were then tested and ranked using the OSU apparatus. The ranking of materials from the OSU tests was identical to that obtained in the full scale fire facility. Thus, the OSU apparatus demonstrated that it would accurately predict what could be expected of interior materials in typical post-crash fires. The proposed acceptance criteria in Notice 85-10 were chosen in order to produce a significant retardation of flashover as predicted by the full-scale testing.

Consideration was also given to establishing separate test methods and standards for interior materials with respect to smoke and toxicity. As discussed in Notice 85-10, this was not done because of the lack of feasible test procedures, and because full-scale tests have shown a significant correlation between flammability characteristics and smoke and toxic emissions.

As proposed in Notice 85-10, all large interior surface materials installed above the floor in compartments occupied by the crew or passengers would have to be qualified to the new flammability standards. This would include sidewalls, ceilings, bins and partitions, galley structures, and any coverings on the surfaces. Smaller items, such as windows, window shades, or curtains, would not be included. Floor coverings, floor structure, seats, and service items would not be included for the reasons discussed in Notice 85-10. In addition to the testing required to meet the new flammability standards, interior materials would still have to meet the current vertical Bunsen burner test because extremely thin materials might not release enough heat to exceed the proposed standards, yet would be highly flammable.

As proposed, Part 25 would require the use of cabin interior materials meeting the new flammability standards for all transport category airplanes for which application for type certification is made after the effective date of the amendment. Part 121 would require the use of such materials in all airplanes newly manufactured two years or more after the effective date of the amendment and operated under the provisions of Part 121 or 135, regardless of the basis for type certification. (Section 135.169(a) incorporates the provisions of § 121.312 by reference insofar as operations with large airplanes are concerned.) In addition, all other large airplanes certificated after January 1, 1958, and operated under the provisions of Part 121 or 135 would have to be modified to use such materials the first time the cabin interior is replaced after a date two years from the effective date of the amendment.

The public comment period for Notice 85-10 originally closed on July 15, 1985; however, as announced in Notice 85-10A (50 FR 30447; July 26, 1985), it was reopened until September 9, 1985. Subsequent to the issuance of Notice 85-10, an industry trade association and the FAA Technical Center completed two series of round-robin tests to assess the reproducibility of test results using the OSU rate of heat release apparatus among various laboratories. In the round-robin testing, the same group of materials was tested by each laboratory. This assessment was necessary because preliminary testing by the industry to evaluate the cost impact of the proposed rule yielded results significantly different from those obtained using the FAA OSU apparatus. During the retesting, several materials representative of inservice interior panels were tested by the FAA, Ohio State University, and two large airplance manufacturers. The first series of tests completed subsequent to issuance of Notice 85-10, indicated that the FAA apparatus had an incorrect heat flux calibration, and there were several significant areas where other test apparatus differed from that of the FAA. The non-FAA test apparatus were modified to more closely match those of the FAA. After the second series of round-robin tests, much closer results were achieved among the laboratories.

Based on the round-robin tests, the Technical Center recommended certain adjustments in test procedures and acceptance criteria. In particular, the recommendations include: (1) Adjustment of the specimen exposure heat flux from 5 watts per square centimeter (W/cm^2) to 3.5 W/cm^2; (2) elimination of the oxygen depletion method of measuring heat release, leaving only the thermopile mehtod; (3) adjustment of the acceptance criteria for total heat release over the first two minutes of sample exposure from 40 to 65 kilowatt-minutes per square meter; and (4) inclusion of a requirement for a peak heat release rate of 65 kilowatts per square meter.

In Notice 85-10A the FAA proposed a change to the exposure heat flux from 5 W/cm^2 to 3.5 W/cm^2. The value in Notice 85-10 was based upon the incorrect heat flux calibration as discussed above. When the proper calibration was utilized a heat flux of approximately 3.5 W/cm^2 resulted. Thus, the change in Notice 85-10A was merely to correct the heat flux value and resulted in no significant change to the test results from those experienced when the incorrect 5 W/cm^2 value was used.

Measurement of the heat release rate by the oxygen depletion method in addition to the thermopile method was proposed in Notice 85-10 because the former was believed to be the more accurate and consistent method as shown by initial testing. During the subsequent series of tests, the thermopile method was found to provide test results that were consistent with those of the oxygen depletion method. Because use of the oxygen depletion method adds to the complexity of the test and the equivalent is more difficult to maintain, the FAA recommended that it be deleted in Notice 85-10A.

The FAA proposed in Notice 85-10A to increase the acceptance criteria for heat release over the first two minutes of sample exposure from 40 to 65 kilowatt-minutes per square meter in conjunction with a maximum peak heat release limit of 65 kilowatts per square meter. The requirement for maximum peak heat release would safeguard against the use of materials which have relatively low levels of total heat release but which, nevertheless, emit a large amount of heat over a short duration. The use of such materials could allow fire to spread rapidly through a cabin. During the series of round-robin testing there were numerous changes made to the test procedures from those used to establish that a heat release value of 40 kilowatts per square meter, as proposed in Notice 85-10, correlated with the intended level of safety derived from the full-scale tests. The new test procedures affected the correlation with the full-scale test results and discrimination of materials, such that the heat release value had to be increased to 65 kilowatts per square meter in order to maintain proper correlation. This change in value thus had no effect on the level of safety and discrimination of materials intended by Notice 85-10. As discussed in Notice 85-10A, a copy of the memorandum report containing recommendations made by the FAA Technical Center was placed in the Rules Docket for public inspection and comment during the reopened comment period.

Discussion of Comments

Numerous commenters, comprising airplane and equipment manufacturers, airplane operators, material producers, airplane crew organizations, foreign airworthiness authorities, other government organizations, and an individual, responded to Notices 85-10 and 85-10A. The vast majority of the commenters support the intent of the proposal; however, many believe that the test method is not sufficiently developed and that the FAA economic analysis of the proposal is understated. The following FAA responses to comments are discussed according to the subject matter of the comment.

One commenter believes that the standards for flammability of interior materials presently contained in § 25.853 are sufficient in light of the recently adopted standards for flammability of seat cushions, smoke detectors and hand-held fire extinguishers. The commenter further believes that the chances of survival would have diminished long before flashover occurs due to the intense heat required for flashover.

The FAA finds that, while the recently adopted standards do contribute significantly to the overall chance of survival in a post-crash environment, they do not, in any way, diminish the further improvement that is possible through the use of improved interior materials. Contrary to the commenter's belief, the full-scale tests have shown that safe egress is not precluded until the time flashover occurs.

Several commenters offer views concerning the decision of the FAA not to propose standards for smoke and toxicity. As discussed in Notice 85-10, the full-sclae tests demonstrated a significant correlation between flammability and smoke emission characterisitics in the materials tested. Because of this correlation, it is not necessary to establish separate test procedures for smoke and flammability. Flammability is a more significant factor in survivability than smoke alone. It would, therefore, be inappropriate to establish test procedures and standards for smoke in lieu of flammability. Similarly, the full-scale tests showed that there is a significant correlation between flammability and toxic emissions and that the severe hazard from toxic emissions occurs as a result of flashover in fires involving interior materials. Thus, the new flammability standards indirectly address toxicity by requiring the use of cabin interior materials with reduced heat release rates that delay or prevent the onset of flashover (a condition when high levels of toxic emissions occur). It must also be noted that standards for toxicity would be especially difficult to establish because levels of human tolerance to typical post-crash fire toxicants have not been adequately defined.

Several commenters express their concurrence with the FAA decision concerning smoke and toxicity. Contrary to this view, however, two commenters state that the amount of smoke and toxic gases released in a fire will be determined primarily by the amount of material decomposed by combustion or thermal degradation and that the amount of decomposed material is, in turn, primarily a function of fire propogation across the surface. The commenters conclude from this that the proposed rate of heat release test is not suitable to evaluate these criteria. The FAA Technical Center, in conjunction with the National Bureau of Standards, has previously evaluated possible test means of measuring the rate of flame spread. None were found to be feasible for type certification testing. It should be noted, however, that the full-scale fire tests conducted by the Technical Center did involve rapidly spreading flames. The correlation of the rate of heat release tests with the full-scale tests has shown that heat release is an indication of the rate of flame spread; therefore, the FAA does not concur with the commenters' conclusion.

One commenter questions the FAA decision not to adopt criteria for smoke and toxicity with respect to in-flight fires originating behind panels. As stated previously, the criteria proposed in Notices 85-10 and 85-10A was based upon post-crash external fuel-fed fires. These represent the largest percentage of fires resulting in injuries or fatalities. While the long term effects of smoke or toxicants from hidden in-flight fires is of concern to the FAA, additional research is necessary to define the essential fire parameters and identify valid, realistic material performance criteria. Rather than delay this rulemaking until a complete fire solution is available for in-flight fires originating behind panels, the FAA believes it is important to potential occupant survival in post-crash fires to proceed with this rulemaking and address the in-flight fire hazard at a later date through FAA research being conducted to evaluate the hidden fire threat.

Two commenters request assurance that no further rulemaking with respect to smoke and toxicity is anticipated in the foreseeable future. Based on the information currently available, the FAA has no plans to establish standards for either smoke or toxicity, however, this does not preclude taking such action in the future if, as noted above, further research shows such standards are warranted and human tolerance levels can be adequately defined.

One commenter believes that the rate of heat release test is costly and unnecessary. In lieu of this test, the commenter proposes to revise § 25.853 by eliminating the 12 second vertical test and requiring that all materials pass the 60 second vertical test. The allowable burn length would also be reduced from six inches to three inches, and standards for smoke and toxicity would be established. The FAA does not concur that the commenter's proposal would achieve the desired improvement in post-crash survivability. The interior materaials that would have to meet the proposed rate of heat release test are, in fact, currently required to pass the 60 second vertical test in accordance with § 25.853(a) and paragraph (d) of Part I of Appendix F to Part 25. Thus, the commenter in effect is proposing to do nothing more than is presently being required, the end result being no improvement in material flammability. Also, the Bunsen burner test is not an adequate test to predict the behavior of materials when subjected to the high radiant heat of a post-crash fire. Smoke and toxicity standards are not considered appropriate or feasible for the reasons noted above.

One commenter believes that the vertical Bunsen burner test currently required by § 25.853 should be deleted because materials which will pass the proposed rate of heat release test will also pass the veritcal Bunsen burner test. The FAA concurs that typical interior materials which will pass the rate of heat release test will easily pass the vertical Bunson burner test. It is possible, however, that an extremely thin material might not release enough heat to exceed the proposed standards, yet would be highly flammable. The vertical Bunsen burner test is relatively simple and inexpensive to perform. It is, therefore, retained to ensure that unacceptable thin, highly flammable materials which would pass the rate of heat release test will not be used.

One commenter questions why the flammability standards proposed in Notice 85-10 were not also proposed for transport category rotorcraft which are type certificated under the provisions of Part 29 of ths Chapter. The FAA research and development program, which led to the proposed standards, was based on a typical post-crash, externally-fed fire scenario involving a large airplane. The scenario assumed that, due to the size of the airplane, at least some of the occupants would be distant enough to survive the initial outbreak of the fire. Delaying the involvement of the entire cabin in the fire would, therefore, afford occupants more time in which to safely egress. Due to their relatively small cabin size, this scenario would not be applicable to typical transport category rotorcraft. Additional investigation would be necessary to establish typical rotorcraft post-crash fire scenarios and to determine whether realistic suvivability improvements could be expected. There is reason to believe that the new technologies in interior materials created by persons complying with this rule would be used in other categories of aircraft without regulatory action.

Two commenters request the exclusion of smaller transport category airplanes from compliance with the proposed flammability standards. One of the two notes that the economic benefits of the proposed standards would not be realized for smaller transport category airplanes and that the accident record of such airplanes should be examined separately. The other commenter notes that the smaller transport category airplanes are frequently outfitted with more luxurious executive type interiors and subsequently used for executive charter or air taxi operations under the provisions of Part 135. The commenter notes that the materials tested during the FAA research and development program reflect the more mundane interiors found in air carrier cabins with high density seating and do not reflect those found in the more luxurious executive interiors. The commenter further notes that the evacuation time needed for smaller transport category airplanes is greatly reduced when compared to large, high density airline airplanes and, therefore, the exposure to heat, smoke, and fumes from burning material is greatly minimized. The commenter suggests that airplanes of 30 passenger capacity or less operating under the provisions of Part 135 should be excluded from compliance with the new standards.

The FAA concurs that the research and development program which led to the proposed standards was based on a scenario involving a larger airplane and may not have produced data directly applicable to the smaller transport category airplanes. Also, the FAA concurs that the time needed to evacuate smaller transport category airplanes with relatively few passengers is much less than that needed for large, high density airline airplanes. The FAA does not agree, however, that the materials tested are not representative of interiors that might be used in executive interiors used in Part 135 operations. To the contrary, the materials used in executive interiors would fall within the range of materials tested and thus the proposed criteria would be appropriate for executive interiors. Even if materials are used that are outside the range of the materials tested, the proposed criteria would still be adequate since they are based upon unchanging laws of physics and ensure an appropriate level of safety. While the FAA believes that there is a size of airplane at which the expected benefits from the proposed rule will significantly diminish, results of past flammability tests provide no basis to exclude airplanes of 30 passenger capacity or less. Furthermore, no data was presented by the commenter to justify its proposal. Thus, the FAA has looked to existing safety standards to delineate a logical airplane capacity below which compliance with the proposed rules is not required.

A maximum capacity of 19 passengers has been recognized previously as an appropriate dividing line in a number of issues involving cabin safety. For example, § 135.107 requires a flight attendant to be on board an airplane operated under the provisions of Part 135 with a passenger seating capacity greater than 19. Similarly, 19 passengers is the maximum seating capacity with which normal category airplanes may be type certificated under the provisions of Special Federal Aviation Regulations (SFAR) 41 for operation under Part 135. For the same reasons that 19 passengers was chosen as the dividing line in these other issues and for consistency, 19 passengers is considered an appropriate dividing line for the new flammability standards. Accordingly, § 25.853 specifies that the flammability standards apply only to airplanes with passenger capacities greater than 19. This, of course, applies also to airplanes operated under Part 121, as § 121.312 will incorporate the provisions of § 25.853 by reference, and to those operated under Part 135, as § 135.169 incorporates the provisions of § 121.312, in turn, by reference. As discussed above, this amendment applies primarily to a post-crash, externally—fed fire scenario. As also discussed above, the FAA intends to conduct further research concerning the effects of fires in hidden areas. This action does not preclude future rulemaking that would require smaller airplanes to comply with the new flammability standards if warranted by further research.

A number of commenters believe that the regulatory evaluation is in error and that the actual cost will be several times greater than the estimate contained in Notice 85-10 because more testing would be required than assumed in the cost analysis. The FAA has revised the economic analysis for this rule based upon this and other comments addressed later in this document. Compliance with the 65 kilowatts per square meter standard has been extended to 4 years rather than the 2 years proposed to reduce the economic impact of the rule.

Comments suggested the FAA testing was flawed because it only looked at generic materials during the full-scale tests. Commenters also suggest that some generic materials containing certain base resins, such as phenolics, demonstrated good performance while actual in-service panels with the same base resins showed less than desirable results. As a result of these discrepancies in test results, commenters have characterized the OSU rate of heat release test procedures as an unreliable predictor of the performance of materials under expected post-crash fire conditions. The FAA does not agree with these characterizations.

The generic materials were not developed to be completely identical to in-service panels. Instead, they were developed to provide a continuum of test results over a range of expected values for typical in-service panels. It must be understood that the objective of the test was not to establish the behavior of typical in-service panels but to perform enough testing to show that the small-scale OSU apparatus accurately predicted the full-scale test results. It is not necessary to use in-service materials to show this correlation. The FAA believes that the correlation has unquestionably been demonstrated. The fact that in-service panels with base resins identical to those of generic panels tested do not behave in the same manner does not surprise the FAA. The in-service materials have flammable decorative finishes over the basic honeycomb/resin matrix which produces these "apparent" discrepancies. The FAA believes that OSU apparatus results showing some in-service materials behave worse than similar generic materials are accurate and are merely a reflection of the fact that the decorative material diminishes the overall performance of the panel. The FAA believes that commenters suggesting that the rulemaking should be deferred until full-scale testing could be conducted on all in-service materials to properly rank their flammability have possibly misunderstood the basic objectives of the FAA full-scale testing as discussed above.

Commenters also suggested that the rulemaking action was premature because the previously discussed round-robin testing showed that the material tested within a particular laboratory showed inadequate repeatability and the values were not correlatable from laboratory to laboratory. As previously discussed, the differences in test results have already been minimized by the changed test procedures and equipment that have resulted from the two series of tests conducted jointly by the Technical Center and the trade association members. Data presented by the three industry laboratories and the FAA, as contained in the docket, shows good repeatability of results within a particular laboratory. With regard to correlation between individual laboratories, even the industry organization that was generally critical of the OSU test results stated, "While these variations (between lab averages) range in the 10 to 15 percent levels they are considered reasonable, particularly for fire testing with the attendant problems and the tendency for each fire to have its own personality." The FAA concurs with this commenter and believes the level of correlation to be very good and well within the range expected for flammability testing. The FAA further believes that the test correlation and repeatability demonstrated by the second series of round-robin tests clearly demonstrates the adequacy of the OSU apparatus as a discriminator of materials to a level necessary to proceed with this rulemaking. The FAA still believes there are additional improvements that could be made to improve correlation and is further evaluating the discrepancies between the four laboratory test apparatus. The FAA plans a third series of round-robin tests to assess what improvements can be made in test results correlation. Nevertheless, the FAA clearly believes the present demonstrated correlation is sufficient to proceed with use of the proposed OSU test apparatus and will enhance the level of fire protection safety.

Commenters also note that the OSU rate of heat release apparatus specified for compliance with the proposed flammability standards is costly and not widely available. Presently, the FAA is aware of four laboratories that have the OSU rate of heat release apparatus in use for testing airplane interior materials for certification. One is in use at OSU on a consulting basis, two are used by domestic aircraft manufacturers, and one is used by a European aircraft manufacturer. Fifteen other laboratories in the U.S. currently use OSU rate of heat release apparatus for non-aircraft applications. Presumably these would also be available for aircraft use, if needed. It is anticipated that other laboratories will acquire the OSU rate of heat release apparatus as the need develops. While the OSU rate of heat release apparatus is more costly than the Bunsen burner required to show compliance with the present standards, the FAA is not aware of, and commenters have not proposed, any other test method that is a satisfactory means of showing compliance with the new flammability standards.

Commenters disagree with the statement in Notice 85-10 that, "there is no cost associated with switching manufacturing processes to use only materials which comply with the proposed tests." As an example, one commenter cites the change from thermoformed parts to resin impregnated glass fiber which involves high cure temperatures and special tools. The statement in Notice 85-10 was based on the assumption that the already widely used material, which was found to give the minimum acceptable performance in the full-scale testing, would be retained and could be used to replace materials that do not meet the new flammability standards. The FAA does concur, however, that additional costs would be incurred in switching to materials requiring new manufacturing processes. Another commenter disagrees with the assumption that, of six types of airplanes now in production, each has only four types of panels (sidewalls, partitions, ceilings and storage bins), making a total of 24 types to be evaluated. The commenter notes that many more tests would have to be conducted due to variations in size, materials, decorative finish, etc. Commenters also note that tests would have to be conducted as part of the quality control process, as well as for type certification. It should be pointed out that tests are already required to establish the quality of interior materials. The FAA anticipates no significant increase in the amount of testing necessary to establish the quality of the manufactured materials, although it concedes that some quality testing may be of a more sophisticated and thus more costly nature. The regulatory analysis for this rulemaking has been updated to consider these comments and ither information provided by the various commenters.

Some commenters believe that additional full-scale tests should be conducted to verify that the new flammability standards are appropriate. The FAA does not concur. As stated before, full-scale testing using generic materials has shown the small-scale OSU test procedures to be appropriate in predicting material behavior. There is no reason to believe that the suitability of in-service materials will not correspond to the results provided by the generic materials tested.

Two commenters believe that the two year compliance period for newly manufactured airplanes would be unnecessarily long. One of these suggests that a period of one year would be appropriate. On the other hand, a number of other commenters believe that two years does not allow sufficient time to select new materials, evaluate their feasibility, conduct the necessary qualification tests, develop any new manufacturing processes, and place orders. They note that the normal procurement process requires components to be ordered at least one year prior to the time the airplane for which they are intended is completed. One commenter suggests a compliance period of five years. The FAA considers five years to be excessive but, in view of the above factors, does concur that the proposed two year compliance period might be too short. The FAA believes that the requirement to meet the heat release value of 65 kilowatts per square meter within 2 years imposes a greater burden on the industry than originally expected. The FAA further anticipates that the amount of developmental testing necessary and the need to develop new manufacturing processes makes the two year compliance period unrealistic. The FAA believes a 4 year compliance time is more appropriate to comply with the heat release value of 65 kw/cm^2, but wants to preclude some of the highly flammable materials identified during FAA testing from being installed during that 4-year period. Thus, the final rule contains an interim 2-year period after which interior materials used in newly manufactured on completely replaced interiors must have a heat release value of 100 kilowatts per square meter or less. The FAA choose the 100 kw/cm^2 value because tests show that value eliminates materials which are clearly unacceptable to both the FAA and commenters. The standard provided by this value will prevent the use of these materials during the interim period. These intermediate standards will preclude the use of materials found to be especially flammable, such as acrylonitrile-butadiene-styrene (ABS) and polycarbonate. The intermediate standards will result in an early incremental increase in safety and will prevent any degradation in the present level of safety due to increased use of these materials.

As proposed, all large airplanes type certificated after January 1, 1958, and operated under the provisions of Part 121 and 135 would have to be modified to use materials that meet the new flammability standards the first time the cabin interior is replaced after a date 4 years from the effective date of the amendment. The selection, qualification and procurement processes for operators are essentially the same as those for manufacturers of new airplanes. An interim period of 2 years with intermediate standards has also been imposed for the reasons cited above with respect to newly manufactured airplanes. (As also noted above, the requirement will apply to airplanes with passenger capacities greater than 19, rather than all "large airplanes".)

Several commenters request clarification of the expression "upon the first replacement of the cabin interior", as used in proposed § 121.312(a)(2) and (3). As discussed in Notice 85-10, the replacement of individual panels on a piece-meal basis would not significantly increase the level of safety and might result in parts incompatibility. The intent of this expression is, therefore, to require the use of the new materials whenever there is a substantially complete replacement of the interior materials that are subject to the new flammability standards. Whether other interior items, such as seats, flooring, etc., are replaced or retained is not relevant to a determination that interior materials meeting the new flammability standards must be used. The term "substantially" is used to ensure that materials meeting the new flammability standards are used when minor components not significant to the overall interior flammability are retained. Refurbishment of interior components by replacing the decorative finish would not constitute "replacement" provided the refurbished components are reinstalled in the same airplane. On the other hand, components removed from one airplane, refurbished and installed in another airplane on a rotational basis would have to meet the new flammability standards. Paragraphs 121.312 (a) (2) and (3) have been reworded to clarify their applicability.

Two commenters believe that the interior materials should meet the new flammability standards within five years after the effective date regardless of whether they are replaced for other reasons. A mandatory retrofit was not proposed for the reasons cited in Notice 85-10.

As proposed in Notice 85–10, all larger interior surface materials installed above the floor in compartments occupied by the crew or passengers would have to meet the new flammability standards. This would include sidewalls, ceilings, bins and partitions, galley structures, and any coverings on these surfaces, but would not include smaller items, i.e., windows, window shades or curtains. Several commenters offer views or request clarification as to the interior materials that would have to meet the new standards. In particular, commenters question whether the new standards would apply to complex door moldings and clear or translucent plastic components, e.g., light lenses in ceiling panels, other light lenses, and window anti-scratch panels. One commenter notes that materials used in sidewalls and panels at low level in high wear areas should be exempted. The commenter asserts that requiring such materials to meet the new standards would provide little benefit and cause considerable cost. Similarly, another commenter believes that the exclusion of some low-priced, high wear parts could significantly reduce the cost impact of the regulation without reducing the resultant benefits. Other commenters believe that materials used in internal galley structure and those used in the internal construction of stowage compartments should be exempted because such materials would not be exposed to direct flame impingement. On the other hand, one commenter believes that the new standards should apply to passenger service units. Another believes that they should apply to curtains and shades.

The primary purpose of the new flammability standards is to ensure that interior materials with large outer surface areas will not become involved rapidly and contribute to a fire when exposed to flames. The internal structure of galleys and storage bins need not meet the proposed standards because such structure would not be exposed to an external flame until well after flashover occurs and further egress is unlikely. The new flammability standards do not apply to transparent or translucent components such as lenses used in interior lights and illuminated signs, and window anti-scratch panels, because of the lack of materials which will meet the flammability standards and still have the light transmissibility characteristics which are vital in emergency situations. Because of their relatively small volume and surface area, small parts (e.g. door and window molding, seat trays, arm rests, etc.,), need not meet the new flammability standards. For the same reason, small detail parts of the passenger service units need not meet the new standards. Any large surface areas of passenger service units that comprise the undersides of the overhead storage bins would, however, have to meet the new flammability standards because they could contribute significantly to a fire. The FAA does not concur that requiring materials used in sidewalls and panels at low level in high wear areas to meet these standards would provide little benefit and cause considerable cost. During the full-scale testing, it was found that there is very little involvement of flooring until after flashover. This is not true, however, of side panels and partitions, even the portions near the floor. While some of the materials that are traditionally used for high wear areas might not meet the new flammability standards, there are other available materials that are feasible for this purpose. Section 25.853(a-1) has been reworded to clarify the applicability of the new flammability standards.

While the comment that curtains and shades should have been included goes beyond the scope of the notice, it is noted that curtains and shades were not included in the proposed rulemaking because no materials meeting the new standards were considered feasible for such use.

As announced in Notice 85-10A, the FAA has recommended that the heat release rate be measured by the thermopile method alone. Due to conflicting test results, several commenters also express the belief that only one method should be used. Two believe that the oxygen depletion method is superior to the thermopile method; however, most support the FAA. The two series of tests conducted by the industry trade association and the FAA have shown that the thermopile and oxygen depletion methods provide consistent results. The thermopile is an integral part of the OSU test apparatus, while the oxygen depletion method would require additional expenditure for added test equipment. The thermopile is, therefore, adopted as the sole method of measuring the rate of heat release.

Several commenters note discrepancies and typographical errors concerning the oxygen depletion method. As only the thermopile method will be used, these comments are no longer relevant.

One commenter believes that the radiant heat flux of 3.5 W/cm^2, is too low, while another expresses the opposite view. A third commenter speculates that testing with one heat flux level does not seem to be sufficient for characterization of burning behavior. As noted above, the two series of tests conducted jointly by the FAA and members of the industry trade association showed that the correlation with the full-scale tests was much better and the results were more consistent with 3.5 W/cm^2. Testing with more than one heat flux level is not considered appropriate because the results of tests conducted at one level would not be consistent with those obtained at another level. In view of the above, a radiant heat flux of 3.5 W/cm^2 is adopted in lieu of 5.0 W/cm^2.

One commenter believes that an independent group, such as the Center for Fire Research at the National Bureau of Standards, should review this matter to determine whether the recommended changes are warranted. The FAA does not concur because the recommendations are based on sound test results, and an independent review would unduly delay introduction of improved materials in service.

Several commenters express their concern that testing specimens in a vertical position is not adequate for materials that melt and drip, i.e., thermoplastics and thermoplastic composites. Based on their experience in testing such materials, the FAA Technical Center recommended the use of a wire mesh to hold the specimen in place and a drip pan to collect molten material. As noted above, the recommendations of the Technical Center have been adopted; therefore, no further difficulties in this regard are anticipated.

Two commenters note that the OSU test apparatus, as described by ASTM-E-906, is still a research tool and should not be used as a means of regulatory compliance. One of the two notes that it is restricted by ASTM to use in research and development because no data were presented to show a correlation between small-scale and large-scale tests. While such correlation may not have existed at the time ASTM standardized and adopted the OSU test apparatus, adequate correlation has been provided by the tests conducted by the FAA. The FAA, therefore, does not concur with the commenters in this regard.

One commenter suggests basing the flammability standards on qualification of base materials rather than by qualification of completed components so that the cost of interiors installed and approved by supplemental type certificates, i.e., those installed by modifiers as opposed to those installed by the original airplane manufacturer, would be minimized. The two series of tests conducted jointly by the FAA and members of the industry trade association have shown that design features, i.e., the decorative finish, have a very significant effect on the flammability characteristics of a component. While a means might be developed in the future to extrapolate the results of testing the base material to the completed component, there is presently no assurance that the completed component meets the flammability standards unless the component itself is tested. Also, there is no justification for allowing the flammability standards for interiors installed by an airplane modifier to be lower than those required for the original manufacturer of the airplane.

Several commenters note deficiencies in the figures that describe the test apparatus, particularly Figure 1. The figures have been revised to correct these deficiencies and to reflect other changes believed necessary by the FAA. Other commenters note typographical errors in the text of the proposed rulemaking which have been corrected.

One commenter notes that the fuel used in testing interior materials is not kerosene as in a post-crash fire and as specified for seat cushion testing. The test fuel is not part of the testing, per se. It is merely a fuel with a standard heat value that is used to calibrate the test apparatus. The radiant heat used during the actual testing is generated electrically. The test fuel was specified as "methane or natural gas having 90 percent or more methane" in Notice 85-10. In order to improve consistency of test results, the test fuel is specified as "at least 99 percent methane" in the final rule.

One commenter inquires as to whether the FAA had performed a comparison of materials which meet European Standard ATS 1000 with those that meet the standards proposed in Notice 85-10. The FAA has not made a direct comparison of materials. It is noted, however, that ATS 1000 consists essentially of a vertical Bunsen burner test, a smoke emission test similar to that proposed by the FAA in Notice 75-3 (40 FR 6505; February 12, 1985) and later withdrawn, and a measurement of toxic gas emissions. ATS 1000 would, therefore, provide no assurance that a material would meet the flammability standards proposed in Notice 85-10.

One commenter notes that ASTM E-906 defines the upper and lower pilot burners as alternatives representing nonimpinging and impinging ignition sources, respectively, and inquires as to why simultaneous exposure to both burners was proposed in Notice 85-10. Exposure to both burners was proposed because the testing conducted by the FAA Technical Center showed that test results are more reproducible when both burners are used.

Several commenters note problems in burner construction and adjustment. These problems were corrected by changes recommended by the FAA Technical Center and adopted in this final rule.

Since the time Notice 85-10 was issued, existing Appendix F of Part 25 has been reidentified as Appendix F, Part I, the new standards for flammability of seat cushions have been adopted as Appendix F, Part II (Amendment 25-59; 49 FR 43188; October 26, 1984), and standards for cargo or baggage compartments have been adopted as Appendix F, Part III (Amendment No. 25-60; 51 FR 18236; 5-16-86). The new standards for flammability of interior materials are, therefore, reidentified as Appendix F, Part IV. Other nonsubstantive conforming editorial changes have also been made.

Additional Round-Robin Testing

Since the opening of the comment period some commenters have expressed concerns regarding the repeatability of the FAA OSU test apparatus and procedures. The FAA plans to conduct a third series of round-robin tests in August, 1986. The FAA is confident that the final series of round-robin tests will simply reconfirm that any apparent disparity between laboratories is primarily a function of inconsistent calibration.

Nevertheless, the third round-robin is expected to be completed in August, and the test data will be placed in the docket within 30 days of completion of the tests. If the tests do in fact reveal that changes in the final rule are necessary, we will publish an appropriate notice in the *Federal Register* within 60 days of completion of the testing.

Request for Comments

As stated before, the FAA believes that the results of its research and the second series of round-robin tests clearly demonstrate the efficacy of this amendment. Very late in the regulatory process the FAA received a comment indicating that the two industry organizations involved in the round-robin testing had identified a better test procedure to discriminate materials. No data was presented to give the FAA confidence that a suggested test procedure was either attainable or correlatable with past FAA full-scale testing. The FAA knows of no other tests which presently show promise of correlation and is skeptacle at this point because the SAFER panel of experts (which contained representative from the aboved-discussed industry organizations) recommended the OSU appartus and the FAA evaluated several other possible test procedures before selecting the OSU tests. Nevertheless, based upon this comment and an apparent feeling by most of the commenters that the FAA is moving too rapidly in this rulemaking, the FAA is requesting further comments on both the test procedure and the appropriatness of the 65 kilowatts per square meter performance criteria.

FAA does not believe the comments received to date warrant abandoning the rulemaking or delaying it further. Based upon results of completed research, the FAA believes that it is time to implement attainable increases in fire safety in transport airplanes. Thus, the FAA has moved to final action on Notices 85-10 and 85-10A. The FAA will review all additional comments submitted and, within 1 year after publication of this amendment in the *Federal Register,* will publish a document discussing all comments, presenting FAA findings based upon the comments, and proposing any necessary revisions to the requirements contained herein. Comments submitted to Docket Number 24594 within 6 months after the publication of this rule in the *Federal Register* will be considered. Procedures identified in Notices 85-10 and 85-10A for filing comments should be followed. Comments should be accompanied by test results as appropriate and commenters should address the cost impact of all suggested revisions to the standards.

Regulatory Evaluation

I. Cost Benefit Analysis

The analysis reviews amendments to Parts 25 and 121 which would upgrade the fire safety standards for materials used in the cabin interiors of transport category airplanes with passenger capacities of 20 or more. Such airplanes will have to use materials which meet the new standards if appliation for type certificate is made after the effective date of the amendment. In addition, other such airplanes used in air carrier service will have to use materials which meet the new standards if they are newly manufactured after a specified date, or for those type certificated after January 1, 1958, if the cabin interior is replaced after a specified date.

The amendments result from FAA efforts recommended by the FAA sponsored Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee. The rule addresses flammability considerations of cabin materials by an improved flammability test.

Compliance with this rule is possible within the current state-of-the-art in cabin materials. The cabin interior components convered are ceiling and wall panels (other than lighting lenses), partitions, and the outer surfaces of galleys, large cabinets and stowage compartments (other than underseat stowage compartments and compartments for stowing small items, such as magazines and maps).

The test procedures used for showing compliance with the new standards are relatively simple. Although the OSU test apparatus is more costly than the Bunsen burner used for showing compliance with the current standards, the cost is minimal when compared with the overall cost of type certification testing for the airplane. Information available to the FAA indicates that the materials used in specific components do not change frequently over the production life of an airplane so that any future cost for type certification testing is incurred infrequently.

The tests already conducted indicate that a number of materials presently used comply with the new standards. Furthermore, these materials cost basically the same as other materials used today, which do not meet the new standards. In view of the established compliance periods, there are no apparent difficulties in substituting these materials for components which fail to meet the new standards. There is no cost associated with switching over manufacturing processes to use there materials in lieu of those which fail to meet the new standards. Some manufacturers may elect to use newly developed materials which do involve new manufacturing processes; however, the additional costs of manufacturing with these new processes are expected to be minimal when compared to the overall cost of manufacturing the components used in cabin interiors.

In light of comments received and other information that was not available at the time Notice 85-10 was issued, the FAA now considers the prelimimary estimate of the cost of meeting the new standards to be too low. The discounted costs are now expected to range between $2.32 million and $2.72 million (mid-point of $2.52) for design, engineering and certification testing to assure compliance for a specific group of panel materials. These are non-recurring costs, and costs after the six years following the effective date of the amendments are expected to be negligible.

The benefits from these amendments result from the increased likelihood of surviving an in-flight cabin fire or a crash which involves a post-crash fire. The improved flammability standards will provide an additional increment of time for passengers trapped in a burning airplane to escape. This, in turn, will allow more passengers to survive in a given situation. The benefits of these amendment s are in addition to those resulting from the improved seat cushion standards contained in Amendments 25-59 and 121-184 because of the additional survival time increment gained and resultant additional lives saved. Unlike the costs, which will be incurred largely over the first four years, the benefits will not start until the fourth year and will increase gradually thereafter as airplanes with new materials are phased into service.

The National Bureau of Standards (NBS), on FAA's behalf, recently conducted an extensive review of all commercial accidents worldwide in which fire was a factor in fatalities. While the NBS study dealt primarily with standards for seat cushions, the conclusions reached with respect to escape time and survivability are equally applicable to these proposals. A copy of the NBS study, Report No. DOT/FAA/CT-84/8, entitled "Decision Analysis Model for Passenger-Aircraft Fire Safety with Application to Fire-Blocking of Seats" and dated April 1984, has been placed in the Rules Docket and is available for public inspection. Based on the results of the NBS study and a monetized value of $650,000 per life, the FAA estimates that the cumulative difference in lives saved and damage reduced by the year 2000 will amount to a discounted benefit of approximately $6.3 million dollars. These benefits are discounted to a present value using a ten percent discount rate. The benefit to cost ratio is, therefore, approximately 2.5 to 1.

The complete economic analysis for these amendments has been place in the Rules Docket and is available for public inspection.

II. *Regulatory Flexibility Act Determination*

A Final Regulatory Flexibility was made in compliance with the Regulatory Flexibility Act. The conclusion in the initial regulatory evaluation, that the amendments would not result in a significant economic impact for a substantial number of small entities, is not altered by the present evaluation.

III. *International Trade Assessment*

These amendments will have little or no impact on trade opportunities for both U.S. firms doing business overseas and foreign firms doing business in the U.S. The amendments affect the rules for certificating new airplanes. Also, newly manufactured airplanes for the U.S. market, whether made by U.S. or foreign manufacturer, will have to comply with the rules. Any cost of compliance is negligible, however, when compared to the cost of designing and testing a new airplane.

CONCLUSION: For the reasons discussed earlier in the preamble, the FAA has determined that this regulation is not considered to be major under Executive Order 12291. The FAA has determined that this action is significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, the FAA certifies that this rule does not have a significan economic effect on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none would be affected. A regulatory evaluation of this action, including a Regulatory Flexibility Determination and a Trade Impact Assessment, has been prepared for this regulation and has been placed in the docket. A copy of this evaluation may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Adoption of the Amendment

Accordingly, Parts 25 and 121 of the Federal Aviation Regulations (FARs) (14 CFR Parts 25 and 121) are amended effective August 20, 1986.

The authority citation for Part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised, Pub. L. 97-449, January 12, 1983).

Amendment 25-62

Standards for Approval of an Automatic Takeoff Thrust Control System (ATTCS)

Adopted: November 4, 1987 **Effective: December 9, 1987**

(Published in 52 FR 43152, November 9, 1987)

SUMMARY: This amendment provides new airplane and equipment airworthiness standards for the installation of an automatic takeoff thrust control system (ATTCS) on Part 25 transport category airplanes. As the current regulations do not provide airworthiness standards for this novel and unusual system, special conditions have been developed and issued to provide appropriate standards for installation of the system. This amendment eliminates the need for special conditions.

FOR FURTHER INFORMATION CONTACT: James Walker, Transport Standards Staff, ANM-110, Aircraft Certification Division, FAA, Northwest Mountain Region, 17900 Pacific Highway South, C-68966, Seattle, Washington 98168; telephone (206) 431-2116.

SUPPLEMENTARY INFORMATION:

Background

Initial development of ATTCS special conditions began in the latter part of 1976. At that time, several airplane manufacturers were known to be interested in such a system or had made application for approval of such a system.

With an ATTCS installed, takeoffs would normally be made with all-engine thrust set at less than the maximum certificated takeoff thrust approved for the airplane. The ATTCS actuates in the event of an engine failure during takeoff to automatically apply maximum takeoff thrust to the remaining operating engine(s). An airplane with such a system installed would have a number of novel and unusual design features that are not presently addressed by the regulations. As such, § § 21.16 and 21.101 of Part 21 require that special conditions be developed and compliance with the special conditions be demonstrated. Special conditions were, therefore, developed for each applicant requesting approval of an ATTCS installation to cover the change in the airplane type design. Note that the term "thrust" is used throughout the discussion even though the normal nomenclature for turbojet is thrust and for turbopropeller is power. No distinction is made in the discussion and "thrust" is used for both.

In November 1977 proposed special conditions for an ATTCS for any two or three engine turbine-powered transport category airplane were developed and sent to interested aviation groups and various foreign civil aviation authorities for review and comment. Comments were reviewed, and the special conditions were revised and sent out for comment in May 1978 and again in November 1978. Cooperating with the FAA in this development were the Aerospace Industries Association of America (AIA), Air Transport Association of America (ATA), Airline Pilots Association (ALPA), Allied Pilots Association (APA), Rolls Royce (RR), Hawker Siddeley Aviation, Ltd. (HS), British Civil Aviation Authority (CAA), civil aviation authorities of Australia and Japan, the French Technical Commission Navigation (FTCN), the French civil aviation authorities, Lockheed, Boeing, McDonnell Douglas, and Rockwell International. As a result of this effort, essentially identical special conditions were issued to all applicants.

The requirements adopted by this amendment incorporate into Part 25 the substance of the special conditions that have been developed and issued to date. Future applicants who wish to install an ATTCS system will have appropriate rules for designing their systems without the need to go through the special condition development process. As in the special conditions, the amendment herein specifies limits on the maximum thrust increment which can be applied to the operating engines by the ATTCS system; prescribes ATTCS system reliability; requires system status monitoring; requires provisions for manual selection of the maximum takeoff thrust approved for the airplane; prohibits approval of the ATTCS system design if the automatic or manual application of maximum takeoff thrust would result in exceeding engine operating limits; and requires an independent engine failure warning indication if the inherent operating characteristics of the airplane do not provide a clear warning to the crew.

In addition, a "critical time interval" definition is included to provide a uniform and acceptable basis for probability calculations.

The basis for this amendment is the special conditions developed for the Boeing 727 and Douglas DC-9 ATTCS designs. The ATTCS installed and approved on those airplane models involved a relatively simple electromechanical system integrated with the engines hydromechanical fuel control unit and was designed to increase the thrust a fixed amount. The system was designed to increase thrust only and no other systems or functions beyond the ATTCS could be interfaced with the ATTCS uptrim function nor could the ATTCS be adversely affected if other systems malfunctioned or failed.

Since certification of the original ATTCS however, a number of others have been approved which were required to comply with the same special conditions issued for the earlier ATTCS designs. Some of the more recent ATTCS configurations installed on some of the latest model turbofan and turbopropeller airplanes have been considerably more complex than the ATTCS approved for the Boeing 727 airplane. These systems interface with the latest designed engine electronic fuel control units (ECU) which use microprocessors and digital computers. The electronic controls command fuel flows for a range of thrust from about 50 percent to full rated thrust in some installations and facilitates the ATTCS 10 percent increment which can be a software program within the basic electronic fuel control configuration. Additionally, these electrical or electronic engine controls interface with and are integrated with, in some installations, other critical or essential engine and airplane systems such as autofeathering, autothrottles and in some instances reverser thrust control systems and surge, stall and overspeed protection.

These interfaces and integrated features make the ECU complex in design and difficult to evaluate in light of the performance and other pertinent design criteria used to find compliance with the special conditions and the applicable airworthiness regulations. However, the FAA considers the ATTCS installation an optional appliance, and it is not an item necessary for the basic airplane certification. Therefore, the FAA policy on ATTCS is that regardless of whether the airplane is ATTCS equipped or not, the airplane must be found to comply with the applicable regulations on its own merits and where an ATTCS is installed and integrated the basic airplane airworthiness must not be compromised by the ATTCS installation, and the ATTCS must comply with the requirements of the proposed amendment. This means that the isolation, separation and fail safe concepts in § § 25.901 and 25.903 must be satisfied regardless of the depth or complexity of the integrated electrical or electronic fuel controls and other critical or essential airplane systems. The FAA considers the fail-safe means, for these ATTCS applications, to be a fail-fixed condition, in that the design of the ECUs would not cause a downtrim or reduce installed engine thrust by a significant amount.

Discussion of Comments

Notice of proposed rulemaking (NPRM) No. 84-4 was published in the Federal Register on April 27, 1984 (49 FR 18240), for public comment. Notice No. 84-4A was published on July 20, 1984 (49 FR 29410), to allow additional time in which to comment. The following discussion summarizes the comments received from the public, industry and foreign authorities and manufacturers.

One commenter disagrees that the proposed regulations provide a level of safety equivalent to that provided by the applicable regulations for airplanes not having an ATTCS installed, as stated in the NPRM preamble. The commenter further states that the ATTCS is an optional system not required for safety purposes and is installed for economic reasons and if it does not function when needed, a lower level of safety could result under certain circumstances than if it were not installed. The commenter feels the installation of an ATTCS should comply with § 25.1309 and be approved in conjunction with the procedures of Advisory Circular (AC) 25.1309-1, System Design Analysis. The commenter believes system failure of the ATTCS should be shown to be extremely improbable to provide the same level of safety under all conditions as if the system were not installed.

This amendment provides equivalent safety since a combined failure of the ATTCS and an engine during the critical time interval must be extremely improbable and the failure of the ATTCS to insert thrust during this critical time interval must be improbable. Under the provisions of this amendment, which are consistent with § 25.1309, it must be extremely improbable that an ATTCS-equipped airplane would fail to meet Part 25 performance flight path requirements below 400 feet. Even in the event of a combined ATTCS failure and loss of one engine, which is extremely improbable, the airplane would be able to continue flight and land since the limit on initial takeoff thrust levels provide assurance that sufficient pilot reaction time will be available to advance the thrust. This limit would prevent penetration of the Part 25 net flight path above 400 feet and would assure that the limiting initial takeoff thrust assures a positive climb gradient.

The same commenter states that the reliability criteria of the ATTCS should be based on the categorical assumption of engine failure like many other system design requirements of Part 25. The reliability criteria imposed on the ATTCS is consistent with the requirements of § 25.1309 and is based on an assumed engine failure during the critical time interval which is required in this amendment.

The same commenter requests that the proposed standards prohibit performance credit for ATTCS when a "reduced takeoff" thrust procedure is used. The FAA has not approved ATTCS credit with "reduced thrust" operations for the several ATTCS installations approved to date by the special conditions. This amendment makes clear that such credit is not approved by restricting the initial takeoff thrust at the beginning of the takeoff (or at the same point normally used to establish the takeoff thrust for non-ATTCS operations, to not less than 90 percent of the maximum takeoff thrust available for the airplane under the existing ambient day conditions.

The same commenter requests that procedures be adopted to prohibit performance credit to increase takeoff gross weight when the system is used on contaminated runways. The FAA does not agree. The provisions of the amendment and of Part 25 regarding accelerate-stop criteria are the same, with the exception that the thrust increase in the interval between engine failure and V_1 due to ATTCS operation must be included in the accelerate-stop distance.

Another request from the same commenter recommends a maximum crosswind be specified so that directional control would not be jeopardized by operation of the system. As part of the original or an amended type certificate (TC), the Airplane Flight Manual (AFM) contains a statement of the maximum crosswind as determined by the ground handling characteristic requirements in the current regulations. In addition, all minimum control speeds are based upon the ATTCS operating as intended so the level of safety provided by Part 25 is maintained.

One commenter expresses concern about § 25.904 being sufficiently flexible to allow future flight management systems and performance management systems to be expanded to manage the takeoff functions an ATTCS now performs. A system designed to perform ATTCS and other functions during the takeoff would be acceptable if it can be shown to comply with both the requirements of this amendment and the requirements for those other functions.

The same commenter recommends that the FAA devise a more objective criterion than the "arbitrary" 10 percent limit. The commenter believes the proposed paragraphs I25.4(b) and (c) may be sufficient by themselves.

In the special conditions, the FAA adopted the value based on a review of the impact that "reduced thrust" operations had on runway-critical takeoffs. A 10 percent value was determined to be a straightforward and acceptable decrement from a safety standpoint in limiting both runway critical takeoffs and degradation of all-engine climb performance factors that are not addressed by paragraphs I25.4(b) and (c).

Several commenters recommend expanding the scope of the proposed standards to include such additional maneuvers as: (1) takeoffs using reduced and derated thrust, (2) thrust reductions during initial climb, and (3) approach climb performance and go-around maneuvers.

The FAA has not restricted ATTCS operations where airplane performance is based on an approved "derate" rating which has corresponding engine and airplane limits approved for use under all weight, altitude and temperature (WAT) conditions. However, the FAA has not allowed the reduced thrust (assumed temperature or weight decrement method) operations to be combined with ATTCS because the resulting flight procedures would increase the pilot workload by creating an infinite number of initial all-engine and engine-failed thrust settings. The increased workload could lead to performance computation errors, and create confusion for the crews workload during a critical high workload engine failure situation. Operationally, noise abatement procedures have already created another set of thrust settings which must be monitored and set. The combination would substantially increase exposure to performance limiting conditions, and this clearly would not be equivalent to current regulations, which are based on a single thrust setting for takeoff. In regard to ATTCS credit for approach climb and go-around maneuvers, current regulations preclude a higher thrust for the approach climb (§ 25.121(d)) than for the landing climb (§ 25.119). The workload required for the flightcrew to monitor and select from multiple in-flight thrust settings in the event of an engine failure during a critical point in the approach, landing, or go-around operation is excessive. Therefore, the FAA does not agree that the scope of the amendment should be changed to include the use of ATTCS for anything except the takeoff phase.

Several comments suggest changing the word "gross" to "actual" in the definition of the "Critical Time Interval" (paragraph I25.2(b)) and in the illustration depicting the definition.

The FAA concurs since the use of "gross" has apparently created some confusion and the meaning is evidently misleading both in the text and in the illustration. Since the word "gross" does not appear in the referenced regulation § 25.115, the word "gross" has been changed to "actual" in both the textual definition (paragraph I25.2(b)) and the illustration. The word "actual" is used in § 25.115(b), although the procedures to determine the actual flight path are defined by § 25.111.

Two commenters request paragraph I25.1(b) be revised by deleting the phrase, "without requiring any action by the crew to increase thrust or power." One commenter thinks the phrase is misleading because several requirements of Part 25 must be met at the maximum takeoff thrust irrespective of whether action by the crew is necessary to obtain such thrust. The other commenter states all the design and flight requirements must be met with the maximum power attained after ATTCS advance occurs and accelerate-stop distances, all engine takeoff, etc., must be accomplished with the power actually available. The phrase "without requiring any action by the crew . . ." was originally inserted into the previous special conditions for the purpose of emphasizing that the ATTCS must automatically function to insert the thrust increment if an engine fails during the critical time portion of the takeoff. The ATTCS is required to perform automatically without pilot assistance to demonstrate compliance and to be consistent with the requirements of § 25.111(c)(4). The inclusion of this requirement in the rule makes it clear that the system design must not require any pilot action in order to achieve a level of safety that would otherwise be required by Part 25. Amendment 25-54 adopted October 14, 1980, amended § 25.111(c)(4) by specifying that no change in thrust requiring pilot action could be necessary until the airplane is 400 feet above the surface. Since that section applies also to airplanes equipped with an ATTCS, the requirement could be deleted as being redundant, but it is retained to emphasize the automatic feature required in all ATTCS systems presented for approval.

One commenter feels the critical time interval (CTI) definition should be changed to read as follows: "The critical time interval is defined as the time from V_{EF} (engine failure airspeed) to the time at which the airplane is not less than 400 feet height above the takeoff surface in the minimum performance takeoff path determined by § 25.111, with ATTCS operative." The justification given for this comment is that this would result in an increase in the CTI and reflect the requirements of § 25.111, which state that the critical engine is made inoperative at V_{EF}. Therefore, any failure of the ATTCS to operate at that point or later will result in a lower takeoff path than required up to the 400 foot point.

The FAA does not concur. The CTI was defined in terms of V_1 (takeoff decision speed) because engine failure speed V_{EF} does not apply to an all-engine takeoff which is used in determining the interval. The additional one second delay prior to V_1 was added to approximate the time interval between V_{EF} and V_1. No further change in severity of the rule is warranted.

Three commenters propose changes to paragraph I25.2(c), the definition of "takeoff thrust" or "takeoff power." One comment relates to the commenters proposal, discussed above, to permit broader basic application of ATTCS to reduced thrust takeoffs and approach and landing maneuvers. As discussed above, the FAA denies the request for expansion of the application of an ATTCS to which this comment relates. Two commenters state that the definition is misleading and erroneous. The definition of "takeoff thrust" or "takeoff power" does not, as previously believed, add significantly to the substance of the regulation. The FAA agrees that in light of the comments received the definition as stated may be misleading and therefore, in the interest of clarity paragraph I25.2(c), has been deleted. Minor changes in other sections where the terms "takeoff thrust" or "takeoff power" are used will be made to clarify their usage.

A number of commenters believe the FAA reliability requirements for an ATTCS and the combined engine/ATTCS system failure probability are excessively conservative and do not match the probabilities with the consequences of the failures. The FAA does not agree. The previous special conditions and this amendment to Part 25 were developed using the principles in § 25.1309 because this was considered the most appropriate method of dealing with complex systems. This amendment evolved from the concepts of § 25.1309 which, in part, state that airplane systems must be designed so that the occurrence of any failure condition that would prevent continued safe flight and landing is extremely improbable and that the occurrence of any other failure conditions which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions is improbable. Also considered in the development of the previous special conditions, which are also the foundation of this amendment, were the establishment of safety equivalency and the requirement of § 25.111(c)(4). Thus, in order to provide a level of safety equivalent to that provided by the current regulations, which preclude credit for pilot actions to change thrust below 400 feet, the probability of the concurrent existence of a combined engine/ATTCS failure must be extremely improbable during the critical time interval. If penetration of the actual flight path which is used to determine obstacle clearance margins is extremely improbable, then the probability of penetrating the net flight path will be the same as that provided by current regulations. A high degree of reliability is necessary for the ATTCS itself. If a reliable system is not provided, confidence in the system would be eroded and crews would be reluctant to use the system, thereby negating the advantages provided through the use of the ATTCS. It was decided that the system's probability of failure to insert takeoff thrust or takeoff power, during the critical time interval, should be improbable and the probability of an ATTCS failure causing a thrust reduction, during the critical time interval, should be improbable and the probability of an ATTCS failure causing a thrust reduction, during the critical time interval, should be extremely improbable. As a practical matter, this requirement is not considered overly severe because of the relatively short time period involved in the specified critical time interval. The reliability is also tied to the requirement that the initial takeoff thrust will be limited to 90 percent of the maximum approved takeoff thrust which essentially assures the airplane will remain airborne without immediate crew action. If this assurance were not provided, a higher level of system reliability would be necessary.

Several commenters express concern about the meaning and intent of a new proposed requirement dealing with the loss of thrust during the critical time interval. Other comments state that the purpose of paragraphs I25.3(a)(3) and (b)(3) was unclear. The FAA agrees that the proposal was not entirely clear as presented in the NPRM. In consideration of the various comments paragraph I25.3(a)(3) of the requirement has been revised to clarify the intent.

After evaluating the several comments in regard to the alternate airplane performance and ATTCS reliability requirements in proposed paragraph I25.3(b), the FAA has decided not to adopt that option in this amendment for the following reasons: (1) deleting the "(b)" option is not considered a significant change since no previous applicant elected to show compliance with these alternate airplane performance and reliability requirements, (2) the "(b)" option does not properly apply to the older vintage airplanes, and (3) section 21.101 provides the flexibility to prescribe any necessary standards for future applications on previously certificated airplanes. Deletion of paragraph I25.3(b) has also resulted in renumbering other paragraphs.

Proposed paragraph I25.3(a)(3) which is incorporated in this final rule as paragraph I25.3(a)(2) required that inadvertent thrust reductions during critical time interval must be shown to be extremely improbable. The purpose of the additional requirement of proposed paragraph 125.3(a)(3), which has not been incorporated in the previous special conditions, is to address those designs that may want to use the electro-mechanical or servomechanism feature of an engine control system (autothrottles, for instance) to perform the thrust insertion function. The ATTCS currently approved have features that are integral with the engine fuel control for increasing thrust. These features are inherently not susceptible to faults which might cut off all fuel to the engines or retard the thrust. On systems which use autothrottle servo-mechanisms or the like to perform the thrust insertion, obviously, a fault of this nature is unacceptable and would likely result in a catastrophe if fuel were cut or thrust reduced a significant amount. Therefore, this failure condition must be shown to be extremely improbable for all ATTCS designs. "Significant loss or reduction in thrust or power" means an engine thrust loss that is more than two percent of the initially set total approved takeoff thrust for the airplane at existing ambient conditions. The FAA recognizes that an ATTCS system using an integrated autothrottle/-servo-mechanism design or similar type of design will inherently have a degree of mechanical tolerance in the rigging of a mechanical designed type and that each engine's thrust control mechanism and system rigging will not be identical to the other engines' control rigging due to various factors in the maintenance, design, and environmental effects. The allowance of such a decrement is reasonable in consideration of the failure consequences and time duration of the critical stage during the takeoff.

Several commenters reviewed the alternate performance and reliability requirements outlined in paragraph I25.3(b) and have similar views to those presented for paragraph I25.3(a). One commenter suggests the paragraph be deleted entirely as being so unduly complex as to nearly nullify the benefits of ATTCS. Another commenter states the paragraph should be modified to delete the specific numerical reliability requirement since this is not appropriate in a regulation and would likely establish a precedent. The commenter states it does not seem justified to ask for the same low probability of failure in paragraphs I25.3(a) and (b) for the same failure case and at the same time ask for extra safety margins. For the reasons stated earlier, the FAA has decided not to adopt the alternate airplane performance and ATTCS reliability requirements in this amendment. Therefore, comments concerning that option are no longer relevant and do not require discussion in this preamble.

Several commenters suggest clarifications in paragraphs I25.3(b)(5), (6) and (7). One commenter suggests the paragraph (paragraph I25.3(b)(5)) clarify that the ATTCS operative V_R is maintained and that reduced V_{LOF} and V_2 speeds are acceptable for the unlikely combination failure. These comments have become moot for the reasons stated earlier. Another comment was to change "gross" to "actual" in paragraphs I25.3(b)(6)(i) and (7)(ii). This comment is no longer relevant for the reasons stated earlier.

One commenter questioned the requirements of paragraphs I25.3(b)6 and (b)(7) and the relationship of the two paragraphs. This comment is no longer relevant for the reasons stated earlier.

Several commenters believe that the limitation on the amount of allowable thrust reduction in paragraph I25.4(a) is arbitrary; that it treats two engine airplanes differently and unevenly from three and four engine airplanes; that it is a crude and somewhat indirect method to ensure that the all-engine performance is not significantly degraded and that a minimum level of performance is available in the event of a combined engine and ATTCS failure; that it restricts and penalizes the performance of certain engine installations; and that it increases operating costs and engine maintenance by not permitting "reduced thrust" takeoffs without increasing safety benefits significantly. The FAA does not agree. The specification of a probability of failure requirement without defining a minimum performance level based on the initial thrust setting is inadequate to assure retention of the level of safety now provided by the regulations. Part 25 engine-out climb requirements not only define a level of safety for the engine-out condition but also define the all-engine performance level consisting of the engine-out requirement plus the added performance provided by the additional operating engine(s). Permitting ATTCS equipped airplanes to operate without a minimum performance level defined in terms of the initial takeoff thrust achieved and verified by the flightcrew early in the takeoff run would ignore the fact that the all-engine level of safety is defined by the existing engine-out requirement. Infringing on this relationship would violate the intent of the regulations. The 90 percent limitation is appropriate and lends itself to a simple, straightforward method for assuring a safe all-engine takeoff in lieu of a more complex performance procedure.

One commenter suggests a revision to paragraph I25.5(b)(1) which would make this paragraph consistent with a previous suggestion which proposed expanding the scope of the amendment. The FAA previously stated that the change was not appropriate and the commenter has presented no new information to alter that determination.

Two commenters disagree with the requirements of paragraph I25.5(b)(2) which require that the means used or allowed to be used to increase thrust, i.e., an override, must be located on or forward of the thrust levers. They disagree this location is necessarily optimum. One commenter believes the objective should be to locate the switch, or means to override, so it is readily accessible and in close proximity to the hand on the thrust levers, preferably close enough so that the hand need not be removed to actuate the switch. The FAA selected the location of the override means as the most practical and convenient under the emergency circumstances likely to exist at the time it is needed. This location is also consistent with the requirements of § 25.777(a), (b), and (c). The main factors favoring the location "on, or forward" of the thrust lever are the normally forward eye scan pattern and line of vision of the pilot during the takeoff, and the convenience of operation provided in the event the pilot must move his hand from the thrust levers to use the override means. Generally, the levers are positioned full forward and the instrument panel is near enough so the panel can be used advantageously to mount the override means. With proper design, this also allows the pilot to actuate the device quickly and makes it unnecessary, in some designs, for the pilot to move his hand from the levers. Locations aft of the levers were deemed unacceptable since these locations were not as convenient for operation and did not fulfill the intent of § 25.777.

One commenter suggests deleting "before takeoff" in paragraph I25.5(b)(3), which would make the language consistent with another suggestion to expand the scope for using the ATTCS. This suggestion was previously addressed and denied; therefore, the suggestion to delete "before takeoff" is not adopted.

The commenter also suggests changing "verify" to "indicate" in paragraph 125.5(b)(3). A means to verify prior to takeoff that the ATTCS is available when and if needed is considered an important part of the overall system requirements. However, the need for a more specific means of indication is not necessary. The current verification means permits the intent to be accomplished without adding more cockpit "indicators." Reliability is closely related to, although not identical to, probability of availability. Having such means to assure system availability prior to takeoff will inherently minimize the possible inadvertent takeoff with the ATTCS inoperative. This requirement is different from paragraph I25.6(a) which requires an indication that the armed or ready mode of operation has been selected.

One commenter states it is not clear that a means to deactivate the system is necessary or desirable in [illegible] instances and recommends the requirement of paragraph 125.5(b)(4) be deleted. The FAA does not agree. A means to deactivate the system is necessary to permit crews to revert to normal procedures in the event of erratic system operation, if ATTCS inoperative takeoffs are made, or if operations using "reduced thrust" procedures (based on the assumed temperature methods), for instance, are scheduled.

One commenter states the requirements for flight characteristics associated with the engine failure are delineated in Part 25 and must be met with or without ATTCS and, therefore, recommends paragraph 125.6(b) be deleted. The intent of this requirement is to provide a warning for the crew that an engine has failed and if the airplane does not yaw, for instance, or provide some other attention getting flight characteristic, then some other warning means must be available to the pilot to advise him of the engine failure and the need to ensure ATTCS power insertion has been achieved on the operating engine(s).

In addition to the changes discussed above, this final rule incorporates a number of clarifying and editorial changes.

Regulatory Evaluation

As discussed above, special conditions have been issued to several applicants to amend or supplement type certificates held on Part 25 airplanes to permit certification with an ATTCS installed. Such special conditions were granted under authority of the Administrator in accordance with § 21.16 because of the novel or unusual design features associated with the installation of this automated system. The ATTCS design features are no longer deemed to be novel or unusual since the standards for their approval are being incorporated directly into Part 25.

In bringing the requirements of the special conditions into Part 25, the FAA is codifying essentially the same optional certification requirements which have been imposed in the last several years. Because the ATTCS airworthiness standards adopted herein will apply only to applicants seeking certification of designs incorporating an ATTCS, and because such systems are optional and not otherwise required for certification, there is no new requirement established by this amendment and no economic impact results from it.

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress in order to ensure, among other things, that small entities are not disproportionately affected by government regulations. The RFA requires agencies specially to review rules which may have a "significant economic impact on a substantial number of small entities." The regulatory evaluation indicated that there is no economic impact associated with the final rule.

CONCLUSION:

For the reasons discussed earlier, the FAA has determined that this document involves a regulation which is not considered to be significant as defined in Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979), and is not major as defined in Executive Order 12291, and the FAA certifies that this regulation will not have a significant economic impact on a substantial number of small entities since few, if any, small entities are affected.

Adoption of the Amendment

Accordingly, Part 25 of the Federal Aviation Regulations (FAR) (14 CFR Part 25) is amended effective December 9, 1987.

The authority citation for Part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983). 49 CFR 1.47(a).

Amendment 25-63

Standards Governing the Noise Certification of Aircraft

Adopted: April 14, 1988 **Effective: May 6, 1988**

(Published in 53 FR 16360, May 6, 1988)

SUMMARY: This final rule revises certain provisions of the regulations prescribing requirements for aircraft noise certification to make them more understandable and easier to use. This amendment also contains substantive regulatory changes simplifying noise certification test and recordkeeping requirements. This regulation is part of the President's regulatory reform program and is based on the body of good engineering practice that has developed since the original adoption of Part 36 in 1969. It also reflects comments received from the general public and the aviation industry in response to a Petition for Rulemaking from the Aerospace Industries Association of America and to an FAA Notice of Proposed Rulemaking.

FOR FURTHER INFORMATION CONTACT:

Mr. Harvey VanWyen, Noise Policy and Regulatory Branch (AEE-110), Noise Abatement Division, Office of Environment and Energy, Federal Aviation Administration, 800 Independence Ave., SW, Washington, DC 20591, Telephone (202) 267-3558.

SUPPLEMENTARY INFORMATION:

The purpose of this revision is to amend portions of the Federal Aviation Regulations (14 CFR Part 36) and amend references to Part 36 contained in other parts (14 CFR Parts 21 and 25). This amendment is based on Notice No. 85-2 (50 FR 4172, January 29, 1985). Comments were invited. All comments have been received and considered in the issuance of this final rule.

SYNOPSIS OF THE PROPOSAL:

Part 36 of the Federal Aviation Regulation (14 CFR Part 36) contains noise standards for aircraft type and airworthiness certification. As the part is currently organized, Subparts B and C and Appendices A, B, and C apply in part to transport category large airplanes and subsonic turbojet powered airplanes regardless of category. This amendment revises these sections of the part to better reflect the actual technical basis for noise certification of aircraft. Substantive changes are made in the noise certification testing, recordkeeping and reporting requirements. The Federal Aviation Administration (FAA) has found that while there will be a substantial cost reduction realized as a result of these changes, there will be no net increase or decrease in noise standard compliance stringency for any class of aircraft. Further, this amendment will not result in any increase or decrease in aircraft noise levels.

Changes in Test Requirements

This amendment to the noise certification test requirements is intended to simplify the noise test procedures, to clarify the purpose of the tests, to update equipment specifications to better accommodate the use of modern digital electronics, and to further reduce the number of flight tests conducted solely for approval of relatively minor aircraft modifications. One such change involves decreasing from four to two the minimum number of sideline noise measuring stations which are used to define the maximum sideline noise. By placing the remaining microphones on either side of the point where the jet aircraft reaches 1000 feet or 1440 feet altitude (AGL), the maximum aircraft noise can be accurately determined at significantly lower costs for equipment, installation, calibration, and data reduction.

Similarly, relative humidity and wind limits on test conditions are eased to maximize available test sites and usable days at those sites. The humidity limit is increased for those applicants using higher-precision instruments, while the wind limit increase is based on wide industry/government experience. The requirement which specifies the location of the meteorological instrumentation is clarified to require that the weather be measured in the vicinity of the noise measuring stations, rather than at the nearest airport.

A number of technical amendments to the analyzer specifications and to the data reporting requirements are adopted to facilitate the use of a wider variety of instrumentation, particularly the newer digital analyzers. Further, because recent computer processing advances make it possible to use data closer to the ambient noise floor and, in some cases, to reconstruct data where parts of the spectrum are below the ambient, greater flexibility is provided to the FAA in approving test and analysis procedures.

One of the major purposes of this amendment is to provide clearer guidelines on the use of nonflight, supplemental tests to meet Part 36 certification requirements. The cost of noise certification of a single jet aircraft type often runs from several hundred thousand dollars to well over a million. Where a long production run of a complex and sophisticated aircraft is anticipated, this cost is generally insignificant when compared to the total development cost of the project. However, to meet the increasingly competitive nature of aviation in this decade, aircraft manufacturers have shortened production runs of standard models and now produce families of related short production run versions. This revision will make it easier to collect a flight data base of sufficient quality and breadth from the first aircraft in such a family so that other related aircraft can be noise certificated using that data base, supplemented by only relatively simple and inexpensive tests and analyses. For instance, noise data from static tests conducted at either the engine or aircraft manufacturer's ground facilities may be approved, as appropriate, by FAA certificating authorities.

Changes in Documentation Requirements

The documentation requirements placed on industry and on individual applicants are reduced as a result of this amendment. These changes will result in lower expenditures in manpower and effort by the government in the review and approval of noise certification documents.

The elimination of certain requirements for prior FAA approval of test procedures greatly simplify the paperwork prior to the test, as well as simplify the test itself. As amended, Part 36 retains the requirement for an approved test plan, albeit a simpler one. Similarly, the certification report requirement which contains the engineering data supporting the certification also remains.

Reduction of the post-certification paperwork, however, is where this amendment works its greatest effect. Previously, Part 36 required that each Airplane Flight Manual (AFM) must contain all procedures that are employed in the flight test, the certificated noise levels, any weight limitations that were required to meet the noise level requirements, and "other information for the flight crew." While this did not appear to be an onerous burden at the time the original Part 36 was adopted, the FAA has found a number of situations where these seemingly simple requirements have resulted in a distortion of the AFM functions. Several large commercial jet aircraft types have been certificated with hundreds of different versions within each type. As a result, the AFMs contain hundreds of pages of noise "information." Under these circumstances, it becomes extremely difficult to identify which data are applicable to any particular airplane on a given day.

The AFM is a required document providing on-board information necessary for the flight crew. It contains specific aircraft performance data, flight procedures, and aircraft limitations vital to the safe operation of the airplane. As indicated above, noise information is also included. However, after careful consideration, the FAA found that it was appropriate to greatly reduce and simplify the noise portion of the manual. Aircraft weight limits or operating configurations required to meet Part 36 certification will continue to be placed in the limitations section of the AFM. However, beyond this, the FAA feels that only the minimum information necessary to obtain a Part 36 compliance statement and the takeoff, approach, and sideline noise levels for that specific airplane configuration is needed. Thus, the FAA clarifies Parts 25 and 36 to preclude the inclusion of inappropriate information in the AFM.

Other Changes

The acoustical change provisions of Part 21 are clarified by specifically excepting from the noise certification requirements several temporary configurations and conditions used for maintenance. Since none of these conditions represents the permanent configuration of any aircraft type, the FAA finds that this action is consistent with Section 611 of the Federal Aviation Act (as amended).

Numerous references to obsolete dates and conditions are removed to shorten and simplify Part 36 while several sections have been retitled more appropriately.

REGULATORY HISTORY

Since its adoption in November 1969, FAR Part 36 has been a significant basis for all Federal aircraft noise regulations in the United States. That regulation was structured to provide a firm, consistent foundation for subsequent rulemaking activities to abate and control aircraft noise.

Part 36 includes precise instructions concerning the acquisition, processing, and documentation of noise data from inflight aircraft. As originally promulgated, Part 36 applied only to turbojet aircraft and propeller-driven transport category airplanes over 12,500 pounds maximum gross weight.

Amendment 36-4 (40 FR 1029, January 6, 1975) added noise certification standards for propeller-driven small airplanes. The noise level limits for certain new turbojets and transport category airplanes were lowered in 1977 by Amendment 36-7 (42 FR 12360, March 3, 1977). In 1978, these lower noise level standards were applied to derivatives of older aircraft types. Noise standards for Concorde supersonic transport airplanes were also adopted in 1978 by Amendment 36-10 (43 FR 28406, June 29, 1978).

Amendment 36-9 (43 FR 873, March 2, 1978), which was adopted in 1978, widely revised the test and analysis specifications contained in Appendices A and B of Part 36. The specifications were expanded to include technical details that had been omitted from the original publication. An example of this was the addition of a section on the calibration of acoustical test equipment. Other changes were made to bring FAR Part 36 into substantial agreement with international standards on noise measurement and with the procedures adopted for noise certification by the International Civil Aviation Organization (ICAO).

The FAA published (47 FR 47854, October 28, 1982) for public comment, a petition from the Aerospace Industries Association of America (AIA) on behalf of its member aircraft manufacturers for amendment of FAR Parts 21 and 36. Notice No. 85-2 (50 FR 4172, January 29, 1985) contained a summary of the comments submitted to the Docket in response to the petition, and the disposition of the issues raised. Notice No. 85-2 also proposed 41 specific changes to Part 36. A discussion of docketed comments on those proposals and the disposition of the issues follow.

DISCUSSION OF COMMENTS

Interested persons have been afforded the opportunity to participate in development of all aspects of this rulemaking by submitting written comments to the public regulatory docket. The period for submitting comments closed April 4, 1985. All comments received have been reviewed and considered in the issuance of this final rule.

Thirteen public comments were received in response to the notice (Docket No. 23340). All of the commenters supported the stated goals and most of the 41 proposed amendments. In addition, nearly every response contained specific suggestions or recommendations about one or more issues.

The comments are discussed below. They are grouped by broad categories of issues.

Acoustical Change

Meeting the noise requirements of Part 36 is one of the steps in the certification approval process for any change to an already certificated aircraft. Included are changes to the aircraft type design which might affect the noise emission characteristics of the aircraft. The definition of acoustical change and the requirement to meet Part 36 standards for design changes within that definition are in Part 21. In Notice 85-2, the FAA proposed to exempt from the definition of acoustical change for turbojet aircraft and transport category large aircraft configured for (a) gear down flight with one or more retractable landing gear down during the entire flight and (b) carriage of a spare engine and nacelle carriage external to the skin of the airplane (and just the pylon or other external mount).

Only two comments were received on this issue. Both supported the proposed change as reasonable and necessary. The FAA agrees and is adopting the modification as proposed.

Aircraft Flight Manual

Over the past several years, there has been some concern that the aircraft operational limits, if any, that are established as a result of FAR 36 noise certification are not being expressed properly in the Aircraft Flight Manual (AFM) when promulgated with reference to the airworthiness limitations. To clarify the intent of the existing regulations, Notice No. 85-2 proposed to add clarifying language in Part 25 (where additional AFM requirements are listed) and in Part 36.

Section 25.25(a) clarifies that the maximum gross weight which meets the noise requirements of Part 36 limits the maximum certification weight. One of the two commenters supported the clarification; the other, a large trade association, reported that some members were opposed while others were favorable. The FAA notes that this provision does not change the regulatory requirement, but simply clarifies the Part 25 certification process by expressly referencing the weight certification requirements of Part 36. The FAA, therefore, is adopting this clarification.

Similarly, Notice No. 85-2 proposed to clarify the definition of Stage 1, Stage 2, and Stage 3 airplanes by categorically stating that each airplane can only be classified in one stage given a specific configuration.

Five commenters responded on this issue. All were opposed to the specific wording proposed for § 36.1(g) because, in their opinion, the words could be interpreted as requiring each airplane to remain within one Part 36 stage. However, none of the commenters appeared to object to the stated intent of the proposal and several suggested small changes in the regulatory language to eliminate the problem.

For more than a decade, the FAA has both encouraged and required the application of available noise reduction technology. The goal has been to move Stage 1 aircraft into Stage 2 and Stage 2 aircraft into Stage 3. In most cases, this has been done voluntarily without the need for regulation. The FAA does not intend to inhibit such actions. Therefore, in light of the comments, the FAA has decided to accept the suggestion of one commenter that the regulation should more clearly indicate that an airplane may not be certified to two stages simultaneously or that an airplane may not, without a change in type design configuration, comply with one stage and then another. Further, it should be noted that current regulations clearly prohibit Stage 2 or Stage 3 aircraft from becoming Stage 1 aircraft.

Notice No. 85-2 also proposed three minor changes in § 36.1581 to clarify that the AFM allows only one certification noise value each for takeoff, approach, and sideline. Since, for flight safety reasons, the AFM on board any airplane may only describe the one current certificated configuration for that airplane, the present rules only require the AFM to have the noise information for that one configuration. As noted in Notice 85-2, the lack of clarity in the Federal Aviation Regulations has caused some manuals to contain detailed noise information on dozens and possibly hundreds of different configurations. The AFM, however, is basically a flight safety document containing vital information for the pilot and crew. While it was determined more than 15 years ago that it would serve a legitimate and useful purpose for the AFM to contain limited noise information, it never was intended for the AFM to become a noise primer on every possible variation in noise levels that might result from changes in configuration, operating procedure, or weather conditions. Thus, Notice 85-2 proposed to consolidate the existing regulations that affect the selection of noise data for the AFM and eliminate the requirement for noise certification test procedures to be included.

Seven comments were received on the proposed amendments to § 36.1581. All agreed with the need to reduce the volume of noise information in the AFMs and with the proposal to eliminate the requirement for noise certification test procedure documentation. Several commenters expressed concern that the FAA's proposed language would limit the use of several "configurations" that have been approved for both safety and noise. The FAA cannot agree.

An airplane is a versatile machine. In most cases, it is designed and built so that it may be operated with different combinations of weight, speed, flap settings, engine power setting, etc. Combinations of these parameters are optimized by the manufacturer for different missions (range payload, speed, weather, runway length, etc.). Each combination is called a configuration. Each configuration, in turn, has clearly stated operating limits involving various parameters. These limits are set by the airplane's manufacturer on the basis of safety. Occasionally, these limits may be further restricted by the manufacturer to lower the noise level of the airplane. The FAA oversees this process on each configuration of every airplane type, maintaining first the highest degree of safety. The FAA's approval is called certification. As a part of this certification, the FAA approves the manufacturer's AFM which contains detailed information needed by the pilot and crew to safely operate the airplane within the limitations of one configuration.

An airline or other operator may purchase from the manufacturer the right to use several different configurations of the same airplane. However, for safety reasons it is vital that the pilot and crew know the limitations applicable to the specific configuration that they are flying that day. Thus, FAA safety rules require each AFM to describe only one configuration at any point in time, no matter how many other configurations the manufacturer has sold to the operator. The proposed changes to § 36.1581 would not change this; they would only restate the existing airworthiness requirement in that portion of Part 36 which deals with AFM information. The FAA believes that this is necessary to avoid confusion. For that reason, the proposed amendments to § 36.1581 are adopted.

Obsolete Dates and Conditions

Numerous references to dates and conditions that are no longer pertinent to present and future applicants for type certification were proposed for removal under Notice No. 85-2. All commenters to the docket endorsed this activity. Three, however, had comments on specific proposed deletions. A U.S. trade association suggested that "(except as provided in § 36.7)" be inserted in § 36.201(b) after the words "type certifications." The FAA does not agree and the language as proposed in the Notice is adopted.

A British trade association and a British manufacturer submitted identical comments suggesting deletion of the provisions, contained in § 36.7(d), which use the engine bypass ratio in determining which provisions apply to applications for "acoustical changes". The FAA agrees that § 36.7(d) should be simplified and shortened. However, the FAA also believes that implementation of this specific suggestion would be neither economically reasonable nor technologically practicable. The differing technologies available to high and low bypass ratio engines require different treatment under the regulation. Thus, the FAA believes that implementation of this suggestion would have the effect of restricting the applicability of Part 36 to new type designs and to the first few derivative configurations. Since adoption of this restriction would prevent the FAA from complying with the intent of Part 36, the FAA declines to accept the suggestion.

Certification Reports

Sections 36.1501 and A36.5 contain the documentation requirements for technical data reports on certification tests and results. Notice 85-2 proposed to clarify the required information and further proposed to specifically allow inclusion of data from supplemental test (such as ground-based static tests of engines). This increased flexibility would allow wider use of cost-saving equivalent procedures as long as the data could be analyzed to yield results that would be equivalent to the results of actual aircraft flight tests.

Only one comment was received on the proposed change to § 36.1501. The commenter opposed the use of "equivalant procedures" such as ground-based static engine tests since such tests by themselves would not be a true measure of the noise increments experienced from an engine change. The commenter states that such changes are often accompanied by changes in nacelles, wing design, fuselage length, and gross weight. The FAA, on the basis of experience, agrees with the reasoning but does not agree with the conclusion. No equivalent procedure has ever been approved (nor would it be under the revised text) under the conditions described where the only supplemental data are those derived from static engine testing. All acoustical and performance data used to develop noise certification levels are based on actual flight tests. The supplemental tests which would be documented under sections 36.1501 and A36.5 are only used to make adjustments to the flight data where it can be shown that there are no other changes to the noise sources, including their relative contributions to the total noise signature. Supplemental flight data or a totally new flight data base might be necessary to derive the noise level numbers under the cited conditions. For these reasons, and because the proposed change would not affect the approval of equivalent procedures but only the test documentation, the FAA disagrees and adopts the language proposed in the Notice.

Two comments were received on the proposed change to section A36.5. Both suggested the inclusion of "appropriate propeller powered aircraft performance parameters relevant to noise generation." While the FAA believes this suggestion may be valuable, its inclusion would be outside the scope of Notice 85-2. The FAA will consider including this concept in future rulemaking.

One commenter also noted that the wording of the proposed revision to section A36.5(b)(5)(vii) would remove the requirement for aircraft height and position data independent of normal flight instrumentation. Since this is a key part of ICAO certification, adoption of the proposed wording could have the effect of invalidating international acceptance of U.S. certifications, along with the attendant economic consequences. The FAA did not intend to remove the requirement for independent height and position data, but agrees that the proposed wording would have that effect. Consequently, the FAA has decided not to adopt the proposed revision of that section.

Test Procedures

Notice 85-2 proposed nine separate changes in the Part 36 noise certification test procedures. In each case, the intent of the proposed change was to lower the cost of certification without significantly diluting the quality of the noise data used for certification.

Seven comments were received on the proposed changes to section A36.1(b). All supported the proposed simplifications, although one commenter expressed concern with regard to the FAA's credibility in administering the noise certification process. It should be noted that the FAA continues its commitment to a strong noise regulatory structure. To this end, the FAA has reviewed these procedures with national and international experts and remains confident that the noise certification process will remain intact and effective. Simplification and cost savings are not being purchased by a decrease in stringency or thoroughness.

In response to a British suggestion, the word "height" is substituted for "altitude" in section A36.1(b)(7) to signify the airplane's height above the local terrain containing the noise measuring sites. Similarly, a test tolerance (500 to 0 ft.) on this height is inserted, because without such a tolerance the airplane would be required to make every test flight 1000 or 1440 ft. above the terrain.

Notice 85-2 proposed to require more accurate measurements of ambient temperature and relative humidity. It also establishes a higher upper limit average wind speed for the microphone and a higher limit crosswind speed average for the aircraft. It also proposed to increase the upper limit average wind speed from 10 knots to 12 knots for the instrumentation and the acceptable crosswind speed for the microphone from 5 knots to 7 knots. The maximum wind speed cannot exceed 15 knots for the instrumentation and 10 knots for the crosswind. The Notice also proposed to clarify that the meteorological variables should be measured in the vicinity of the noise monitors. Widening these weather windows would lower costs to both industry and government by minimizing delays which presently tie up equipment, aircraft, and personnel for days while waiting for specific weather conditions. Five comments were received. One supported the proposal, one wanted to remove all test weather limits under certain conditions, and three foreign organizations objected because of the belief that the Notice proposed maximum winds of 15 knots and crosswind limits of 10 knots. They suggested use of the ICAO limits, 12 and 7 knots, respectively. However, the FAA notes that Notice 85-2 did, indeed, propose the ICAO values of 12 and 7 knots for the upper average limits while also setting maximum values. Therefore, the FAA adopts the proposed revisions.

A number of changes were proposed in the technical specifications for the electronic equipment used in the collection and analysis of the noise data. These changes generally follow the standards adopted by the ICAO and should minimize costs where manufacturers have to certificate to both ICAO and U.S. standards.

Eight comments were received on the proposed revisions to the microphone specifications. Most were general comments on the need to duplicate the ICAO specifications. One specific comment noted that the wording of the last sentence of section A36.3(c)(2)(ii) varied somewhat from the ICAO standard and that this difference would cause applicants difficulty. After considering the issue, the FAA agrees and the amended specification is adopted with the suggested change.

The FAA also proposed to revise the electronic specifications for the noise analyzer. Earlier specifications were based on the analog system used a decade ago. Notice 85-2 proposed, instead, to update this section, based on the digital equipment currently in use. Since ICAO has not yet adopted similar revisions, most of the seven commenters recommended delaying adoption. However, the FAA believes that the problems encountered by both applicants and government in trying to qualify digital systems under analog specifications require the FAA to act. Thus, the proposed revision to section A36.3(d) is adopted. However, should ICAO eventually adopt differing specifications, it is the intention of the FAA to issue a subsequent notice proposing adoption of the ICAO standard in the U.S. In adopting section A36.3(d)(5)(i), the FAA also corrects a typographical error that appeared in the Notice. The correct standard deviation is 0.48 decibels.

Data Correction and Analysis

Notice 85-2 proposed to amend section A36.5 to clarify the information that is needed to correct the data to standard reference conditions in that the referenced atmosphere should be considered to be homogeneous. Specifically, only those engine performance parameters relevant to noise generation, such as net thrust, engine pressure ratio, exhaust temperatures, and fan or compressor rotational speeds, would be reported. Aircraft sound pressure levels need to exceed the ambient background by only 3 decibels instead of the present 5 decibels. The Notice proposed to allow lower signal-to-noise ratios if the method for separating the signal from the noise is approved by the FAA. Several other amendments to Appendices A and B of FAR 36 were proposed that would make relatively minor changes to mathematical constants in the correction procedures or that would make minor revisions in the description of the procedures. These were considered to be clarifying, not substantive, even when the amount of data to be reported was reduced.

Seven of the commenters responded to these proposed changes with suggestions for improving the clarity of the revisions. These minor typographical suggestions have been incorporated.

Other Comments

Several respondents to the docket took the opportunity to make suggestions for additional changes and modifications outside the scope of Notice 85-2. Even though some of these comments appear to have merit, the FAA does not believe their cumulative value justifies a delay in issuing this final rule in order to issue a supplemental NPRM.

SECTION-BY-SECTION ANALYSIS

Part 21

Section 21.93 prescribes the procedural requirements for the approval of changes in type design that may increase the noise levels of an airplane type. Paragraph (b)(2) is amended to add an exclusion for gear down flight with one or more retractable landing gear down during the entire flight and for spare engine and nacelle carriage external to the airplane skin (and the return of the pylon or other external mount).

Part 25

Section 25.25 contains the criteria upon which the maximum weight of an aircraft is based. This section is clarified to note that the highest weight at which compliance is shown with the certification requirements of Part 36 may be, under some circumstances, the limiting maximum weight.

Part 36

The last sentence of § 36.7(c)(1) is amended to clarify that Part 36 noise tradeoff provisions may not be used to increase non-complying Stage 1 noise levels. The Part 36 tradeoff provisions can be used, however, once the modified airplane qualifies as a complying Stage 2 airplane. This could occur, for instance, when the aircraft increase in weight raised the allowable Stage 2 limit by more than the measured increase in noise.

Sections 36.7(d) and (e) and 36.301(b) are revised to remove obsolete language, dates, and references. Sections 36.201(c) and (d) are deleted for similar reasons.

Section 36.1501 is expanded to clarify the need for approval of equivalent procedures and to allow wider flexibility in the use of non-flight test data to supplement approved flight data bases.

Two subparagraphs are added to § 36.1581(a) to clarify that only one value for each noise certification test point for takeoff, sideline, and approach as defined by Appendix C may be placed in the Aircraft Flight Manual, along with associated weight and configuration. Similarly, one value for flyover as defined by Appendix F for propeller driven small airplanes may be placed in the Aircraft Flight Manual. If additional operational noise information is included in the Aircraft Flight Manual, it must be segregated from the certification data in accordance with § 36.1581(b). The old § 36.1581(c) is reworded to clarify its intent and redesignated as (d).

Appendix A of Part 36

Section A36.1(b) is revised to allow flight path intercept tests, rather than requiring only full stop takeoffs and landings for every test. This section is also amended to allow a minimum of two symmetrically-placed microphones to measure the sideline noise rather than the minimum of four currently required. Both changes are expected to provide wider flexibility in the choice of test sites and to significantly lower the cost of such tests.

Section A36.1 is revised to expand the flight test weather window when the dew point and dry bulb temperature are measured with an instrument accurate to within one-half degree Centigrade. The allowable winds during the test are increased to those specified in ICAO Annex 16. The requirements to generate noise level versus weight information for takeoff and approach are deleted.

A number of the technical specifications in section A36.3 are revised to accommodate the use of digital recording and filtering techniques. Section A36.3(e)(7) is revised to require a performance calibration analysis of each piece of calibration equipment at least once every six months.

Section A36.5 contains the requirements on reporting and correcting measured data. Section A36.5(b) is revised to eliminate the need to obtain engine performance data solely from flight instrumentation or manufacturer's data. By this revision, static tests and other sources of supplemental data can be employed. Section A36.5(c) is also amended to indicate that the noise certification atmosphere is homogeneous. That section is also amended to replace an erroneous reference to "design" landing weight with the correct reference to "maximum" landing weight.

Section A36.5(d) is amended to accept one-third octave band data that are at least 3 decibels above the mean background noise in that band. Before this amendment, the data had to be least 5 decibels above ambient. This change permits greater flexibility in the choice of test conditions and is particularly necessary for the test of quiet airplanes. Greater flexibility is also provided by the approved use of time/frequency interpolation and equivalent procedures within the indicated limits.

Section A36.5(e) is revised to add a new paragraph (4) which specifically allows the orderly development of noise certification for certain derivatives of aircraft type design, and provides simplified methods for computing the 90 percent confidence limits for those derivatives.

The requirements in section A36.9(b) for locating meteorological measurements have been changed to permit their placement near the measuring stations, rather than using meteorological data from the nearest airport. This is intended to improve the quality of the meteorological data in those cases where the flight tests are not conducted at an airport. Another change to the meteorological specifications is made in section A36.9(d)(2) where the criterion for using the simplified method for deriving the values of the atmospheric coefficients has been broadened. Accordingly, the simplified method may be used if the atmospheric absorption coefficients do not vary over the sound propagation path of the maximum noise by more than plus or minus 1.6 decibels per thousand feet in the 3150 Hertz one-third octave band.

Section A36.11(a)(3)(v) is amended to delete the requirement for graphical or tabular data presentations during data correction. These corrections may not be done by computer or other appropriate means.

Several small corrections are made to section A36.11(e). One updates a cross-reference to sections A36.11(b) and (c), while the others correct a mathematical constant used in the Delta 2 calculations for takeoff, approach and sidelines.

Section A36.11(f) is completely revised and considerably shortened to provide clearer guidance or appropriate correction procedures when the takeoff and/or approach noise measurements are made at non-standard locations. Two alternative methods are provided.

Appendix B of Part 36

Section B36.5(h) and Table B-2 are revised to eliminate calculation of tone penalties for tones less than 1.5 decibels.

Sections B36.9, B36.11, and B36.13 contain the technical and mathematical details of the methods for calculating Effective Perceived Noise Levels (EPNL). Several small changes are made in the formulation to simplify the computerized procedure.

Appendix C of Part 36

Sections C36.5(c), C36.7(d), and C36.9(d) are deleted as unnecessary and the subsequent sections are redesignated accordingly. Sections C36.7 and C36.9 are retitled to better describe their functions.

REGULATORY IMPACT EVALUATION

The FAA conducted a detailed regulatory evaluation which is included in the regulatory docket. This evaluation assesses the economic impact of all changes to Parts 21, 25, and 36. The FAA has determined that this rule is consistent with the objectives of Executive Order 12291 as part of the President's Regulatory Reform Program to reduce regulatory burdens on the public. This rule imposes no additional costs on the Federal government.

The amendments in this rule will provide benefits in the aggregate to the aviation industry and the general public. These benefits arise from deletion of unnecessary noise certification testing and recordkeeping requirements, clarification of regulatory text, and relaxation of certain test and documentation requirements. The amendments better reflect new technologies and consequently many amendments are clarifying and editorial in nature. As an overall result of these amendments, the regulations are more concise and easier to understand. None of the amendments are expected to result in a major cost to the aviation industry. There are 10 amendments which are expected to yield minimal to minor benefits and three amendments are expected to result in minimal to minor costs. One of the amendments which will reduce from 4 to 2 the number of sideline measurement stations needed as part of the aircraft noise certification process is estimated to save manufacturers approximately $2.0 million discounted over a 10 year period. For the reasons stated above, the benefits flowing from these amendments substantially outweigh any associated costs.

REGULATORY FLEXIBILITY DETERMINATION

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires government agencies to review rules which may have a "significant economic impact on a substantial number of small entities."

These amendments directly impact large manufacturers of aircraft. The FAA size threshold for a determination of a small entity for aircraft manufacturers is 75 employees; that is, any aircraft manufacturer with more than 75 employees is considered not to be a small entity. Based upon this size threshold, the aircraft manufacturers affected by this rule are not small entities. Moreover, of the potential cost impacts, three require minimal computer programing changes which can be accomplished in-house. One of the amendments is estimated to save the manufacturers approximately $2.0 million. The remaining changes are editorial in nature. This rule will not have any significant economic impact.

Therefore, the FAA certifies, this rule will not have a significant economic impact on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

ENVIRONMENTAL ANALYSIS

Pursuant to Department of Transportation "Policies and Procedures for Considering Environmental Impacts" (FAA Order 1050.1D), a Finding of No Significant Impact has been made. These amendments are primarily administrative, clarifying and organizational, and do not significantly affect the quality of the human environment.

CONCLUSION

For the reasons stated above, the FAA has determined that this document involves a regulation which is not major as defined in Executive Order 12291 and not significant under Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979). In addition, the FAA certifies that under the criteria of the Regulatory Flexibility Act this final rule will not have a significant economic impact on a substantial number of small entities. A copy of the regulatory evaluation may be examined in the regulatory docket or obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

THE FINAL RULE

Accordingly, the Federal Aviation Regulations (14 CFR Parts 21, 25, and 36) are amended, effective May 6, 1988.

The authority citation for Part 25 is revised to read as follows and the authority citations following the sections in Part 25 are removed:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

Amendment 25-64

Improved Seat Safety Standards

Adopted: May 12, 1988 **Effective: June 16, 1988**

(Published in 53 FR 17640, May 17, 1988)

SUMMARY: This amendment upgrades the standards for occupant protection during emergency landing conditions in transport category airplanes by revising the seat restraint requirements and by defining impact injury criteria. These changes are based on research testing and service experience and are intended to increase airplane occupant protection during emergency landing conditions.

FOR FURTHER INFORMATION CONTACT: Iven D. Connally, Regulations Branch (ANM-112), Transport Standards Staff, Aircraft Certification Division, FAA, Northwest Mountain Region, 17900 Pacific Highway South, C-68966, Seattle, Washington 98168; telephone (206) 431-2120.

SUPPLEMENTARY INFORMATION:

Background

This amendment is based on Notice of Proposed Rulemaking (NPRM) No. 86-11, which was published in the *Federal Register* on July 17, 1986 (51 FR 25982). The notice proposed to upgrade the standards for occupant protection during emergency landing conditions in transport category airplanes by revising the crew and passenger seat restraint requirements and by defining impact injury criteria.

Transport category airplane seats are currently designed to meet the standards contained in § 25.785 (Seats, berths, safety belts, and harnesses), in § 25.561 (Emergency landing conditions), and in Technical Standards Order (TSO) C39b (Seats). Section 25.785(a) requires that each seat (including a crewmember seat as well as a passenger seat), berth, safety belt, harness, and adjacent part of the airplane be designed such that the occupant who experiences the inertial forces specified in § 25.561 will not suffer serious injury in an emergency landing. The inertial forces in § 25.561(b) are specified as ultimate forces experienced by the occupant and are treated as statically applied loads. The notice proposed to upgrade the static load factors defined in § 25.561 in the upward, downward, and sideward directions, and to add an aft direction requirement.

Notice 86-11 also proposed adoption of new dynamic test standards for seats. The proposed standards would require the demonstration of both occupant response and seat/restraint system structural performance. They would provide a more representative evaluation of the interaction of the occupant, the seat, and the restraint system and yield data for impact injury analyses. Two dynamic test conditions were selected based on impact scenarios developed from analyses of survivable ground impact data. One test condition combines vertical and longitudinal loads to simulate ground impact following a high-rate vertical descent. This test condition emphasizes occupant vertical loading and evaluates the means provided to reduce spinal injury under the loads typically resulting from an impact of this nature. The second test, with a predominantly longitudinal component, simulates horizontal impact with a ground-level obstruction. This test condition provides an assessment of the occupant restraint system and seat structural performance. The selection of these two dynamic test conditions is consistent with the results of the crash scenario studies. These dynamic test standards are considered appropriate for all transport category airplanes, regardless of size.

An important part of any test procedure is the pass or fail criteria. The rule would establish such criteria by defining standards that directly relate selected parameters measured during a dynamic test to injury criteria based on human impact injury limits. The performance criteria would be used to evaluate the occupant/seat protection system potential for preventing or minimizing serious injuries from both primary and secondary impacts. Of major concern are secondary head impacts which can inflict debilitating injuries and result in concussion and unconsciousness. The measure of potential head injury proposed in the notice is the Head Injury Criteria (HIC) used in Federal Motor Vehicle Safety Standard No. 208 (49 CFR 571.208). The HIC is applied when the results of the seat dynamic tests show that structure or other items of equipment are within the occupant's head strike envelope. The head acceleration time history is measured during the dynamic test and evaluated with the HIC when secondary impact can occur.

Spinal injuries also occur in airplane crashes. The Dynamic Response Index (DRI), which is based on a single, damped spring model of the spine and respective support mass, has traditionally been used to predict probability of spinal injury in the performance evaluation of airplane ejection seats. The DRI has been correlated with ejection seat testing and service experience to provide a level of confidence for the application; however, inherent differences in function, geometry, dynamic pulse exposure, and occupant restraint between transport category airplane seats and ejection seats make direct application of the DRI questionable as a performance criterion for transport category airplane seats. A series of dynamic tests of seats in various impact orientations was studied by the FAA Civil Aeromedical Institute (CAMI) to correlate the DRI, determined from measured accelerations at the seat pan, to pelvic loads measured in the spinal base of a modified Part 572 (49 CFR 572) anthropomorphic dummy. Additional testing with transport category airplane seats with a lap belt restraint system indicated that the pelvic load peaks while the anthropomorphic dummy is still seated in a predominantly upright position. These tests confirm that the spinal load injury criteria can be used in assessing the dynamic performance of transport category airplane seats. Pelvic loads can be used in assessing the probability of spinal injury, and they are straight forward, easily measured, and require no additional analysis or interpretation. A maximum pelvic load of 1500 pounds would assure a low probability of spinal injury.

Leg injuries also occur in airplane crashes. While leg injuries alone may not be fatal, passengers may be temporarily incapacitated to the extent rapid evacuation of the airplane is not possible. An injured passenger, in an effort to escape, may block the escape route for several other passengers. Femur loads should therefore be measured during the dynamic tests where leg injuries may result from contact with seats or other structure. A measured axial load of 2250 pounds along each femur should not be exceeded during these tests. This is the same as the maximum allowed by Federal Motor Vehicle Safety Standard No. 208. This procedure provides an easily measured quantity that would require no additional analysis or interpretation.

Crash investigations have shown that localized cabin floor deformation can occur in survivable crashes. This has been confirmed by the controlled impact demonstration and drop tests involving transport category airplanes. The inability of some seats to accommodate such deformations, remain in place, and restrain the occupants can contribute significantly to the degree of injury during a crash. The simulated floor deformation used in the dynamic tests, while not intended to be a measure of floor strength or deformation capability, will demonstrate the tolerance of the seat and its attachments to deformations that could occur in an actual crash.

The static strength requirements of § 25.561(b)(3) would be increased to provide a level of safety for seats and fixed items of mass consistent with the new dynamic test standards and accepted industry practice. It is expected that increased static strength requirements would assure a more uniform level of safety in the cabin floor structure, seat tracks, fittings, fixed items of mass, and in the seats. The increased lateral static strength and the added rearward static strength requirements would also improve the conditions for rapid evacuation during an emergency landing by limiting the obstruction of aisle space.

As proposed, the new seat safety standards would apply to all transport category airplanes for which an application for type certificate is made on or after the effective date, regardless of whether the airplanes are used in air carrier service. The new standards would not apply to airplanes for which application for type certificate is made prior to the effective date, nor to derivatives of such airplanes for which an application for an amended type certificate is made.

Discussion of Comments

The public response to requests for comments on Notice 86-11 demonstrates the wide interest shown in this rule. Comments were received from both airplane and seat manufacturers, from airplane operators, from organizations representing flightcrews, and from U.S. and foreign government agencies. All but two commenters support the FAA's objectives of enhancing the protection of occupants during emergency landing conditions through the use of new dynamic seat test methods and occupant injury criteria; however, several commenters are concerned that these requirements should apply only to future transport category airplane certifications. Most of the commenters also support improvements in the static strength requirements for seats and items of mass.

Several commenters requested extension of the public comment period. They argued that more testing was needed to verify the proposed criteria. The FAA considers that sufficient test data were available to the public to generate meaningful comments on the notice within the allowed time. Newly designed seats have, in fact, been successfully tested using the proposed criteria.

Several commenters recommend static load factors less than those proposed in the notice. They are especially concerned with the side load factor of 4.5 when applied to all interior items. They believe the side load factor of 4.5 would be excessive and could cause significant weight penalties. They recommend a side load factor of 3.0 on the airframe and 4.0 on the seats. The proposed values were selected to take advantage of existing floor strength without requiring a significant structural weight increase. After further review of current airplane designs, both narrow body and wide body, the FAA agrees that a side load factor of 4.5 could add weight and cost to the structure without commensurate gains in safety. The higher load factors for seats, listed in TSO-C39b, are an attempt to represent the design ultimate load factor envelope for the typical airplane; i.e., the most critical location in the airplane for the most critical load condition (flight, ground, or emergency landing). The TSO values are usually higher than the airplane design load factors at the center of gravity and usually lower than these factors at the extreme forward and aft fuselage stations. The data indicate that the floor structure can withstand a side load factor of 3.0 without a significant weight penalty. This would provide a load factor capability of 4.0 on all attachments where the 1.33 factor applies (ref. § 25.785(i)(3)). The data and comments provided to the FAA indicate that load factors of 3.0 upward, 6.0 downward, 3.0 sideward, and 1.5 rearward are within the existing design ultimate strength envelope for most airplanes that would be affected by this rule and are adopted accordingly. One commenter requests clarification on where the 1.33 factor required by § 25.785 applies. The 1.33 factor applies only to the static design conditions of § 25.561.

One commenter states that the proposed increase in static side load factor from 1.5 to 4.5 would increase the ability of the seats to resist lateral deformation under crash conditions and would help maintain passable aisles for emergency evacuations. The FAA concurs that some increase in side load capability is needed. Although the current rule only requires a load factor of 1.5 for emergency landing conditions, most modern airplanes are capable of much higher loads. There is evidence to indicate that seats designed to a load factor of 3.0 have deformed in a sideward direction. The data indicate that seats could be designed to withstand a sideward load factor of 4.0 (i.e., 3.0 times the 1.33 factor) without an appreciable increase in structural weight and, as noted above, this load factor is adopted accordingly.

Comments were received concerning the implications of the proposed revisions to § 25.561(b)(3) on other sections of Part 25 which incorporate the provisions of § 25.561 by reference. For instance, fuel tanks in the center section of the horizontal tail must withstand the fuel pressures resulting from the conditions of § 25.561 if they are within the fuselage contour. The applicability of § 25.561 remains unchanged in this regard, and the newly adopted load factors are applicable to the other sections of Part 25 that incorporate § 25.561 by reference as well.

One commenter suggests that galleys be equipped with fail-safe locking systems to avoid recurrent failure of drawers, bins, ovens, etc. Detail design requirements of latches are not the subject of this proposal; however, Advisory Circular (AC) 25.785-1, Flight Attendant Seat Requirements, provides guidance for latches on galleys.

One commenter states that items and structure which are fixed in cabin location should be designed only for the expected loads at their respective locations. The commenter further states that since seats tend to be of common construction, irrespective of cabin location, and may be relocated easily in service, it is reasonable to design all passenger seats to a maximum load factor. The current rules require that all items and structure must be designed to withstand the loads at their respective locations for all points within the structural design envelope, as well as the loads developed during emergency landing conditions. In this regard, nothing has changed from present certification practice.

One commenter suggests that aft-facing seats might prove superior in terms of both cost and passenger protection. The FAA concurs that aft-facing seats could be designed to provide greater support for the upper torso during crash load conditions; however, there are no currently available data to demonstrate that requiring the use of aft-facing seats would be cost effective, considering the increased weight associated with such seats and the improved occupant protection provided by this rule. Although this amendment permits the use of aft-facing seats, it does not require their use.

According to one commenter, a literal reading of proposed § 25.562(a)(2) would make compliance with this paragraph impossible to achieve. Accordingly, the sentence has been revised to read, "The occupant is exposed to loads resulting from the conditions prescribed in this section."

Several commenters object to the requirement to consider seat tracks misaligned with each other by 10 degrees vertically and one rail rolled 10 degrees to account for floor warpage. They point out that a requirement for the supporting structure to sustain these deformations as per proposed § 25.562(d)(8), while carrying the dynamic loads, is a severe condition outside of the current floor structural capability. The FAA agrees that to require the floor to withstand these deformations without failure would be outside the floor structural capability. The 10-degree misalignment required for testing of seats is intended only to assure a degree of flexibility in the seat structure and floor attachments and is not meant to be a measure of floor structural capability. For this reason, only the forward test condition (§ 25.562(b)(2) requires the 10-degree deformation for testing. Section 25.562 is therefore revised accordingly.

One commenter believes the proposed § 25.562(c) is unclear as to whether these deformations have to be imposed prior to the dynamic tests or whether it is acceptable to show that they have been achieved, or exceeded, during the course of the tests. This commenter also believes the rail misalignment conditions are not necessarily appropriate to all airplanes and that provision should be made for use of alternative definitions of seat support structure deformation. The reason for testing with deformations is to assure that the seats and attachments will carry the dynamic loads even though the tracks have been distorted. The 10 degrees of track and floor warpage are imposed prior to the dynamic tests. Any seat deformation caused by the test will be recorded for use in the assessment of blockage of emergency egress. Although the majority of transport airplanes use tracks to attach seats to the floor structure, the misalignment conditions specified for the dynamic tests also apply to other types of seat-to-floor attachment fittings. It is expected that acceptable limits on deformation will be included in proposed AC 25.562-1 (51 FR 25990; July 17, 1986), and seat manufacturers will supply measured deformations to the installer.

Several commenters interpret proposed § 25.562(c) to require that each seat model and its attachments be tested with unique airframe support structure. The rule does not require seats and their attachments to be tested with unique floor structure. Tests may be conducted on a rigid test fixture with representative seat tracks installed.

Several comments were received concerning the use of various analytical methods. One commenter recommends application of automobile dynamic impact analysis to aircraft. Another commenter suggests that a rational analysis be allowed as an alternative for dynamic seat tests or for adjusting the dynamic pulse to account for aircraft size. The FAA will consider the analytical method as a means of certification only when sufficient experience is available to demonstrate that the analytical methods can accurately predict the site and mechanism of failure of a seat/restraint system, and can accurately predict the injury criteria obtained in dynamic tests for a wide variety of seat designs. At the present time, rational analysis would be allowed only to demonstrate that seats are less critical than similar "worst case" seats which have successfully passed dynamic testing. There is no valid method to adjust the dynamic pulse for aircraft size, material, construction technique, operating environment, or other factors. The dynamic pulse was selected primarily to provide an effective test environment for seat and restraint system evaluation.

One seat manufacturer states that testing of each seat is impractical and suggests that § 25.562(b) be reworded to read, "Each seat type approved . . . must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests . . . ." The FAA concurs with this recommendation, and § 25.562(b) has been revised accordingly. The FAA does not concur with the suggestion that static minimums should be verified by actual testing rather than by analytical methods. Structural static analysis may be used if the structure conforms to that for which experience has shown this method to be reliable.

Some commenters suggest that crew seats, including flight attendant seats attached to bulkheads and galleys, should be subjected to static tests only. The FAA does not concur. There is no justification for providing a lower level of safety for crewmembers. Also, there is no way to demonstrate injury protection parameters (injury criteria) with static tests. One commenter suggests use of submarining indicators on the pelvis of the dummy to permit objective assessment of belt retention. While this may be a good idea, it requires a dummy with a special pelvis, which is costly and not commonly available. Submarining action can also be detected by inspection of the dummy after the test and by careful review of the test films.

One commenter provided analysis to support the position that the pulse shape for both vertical and longitudinal tests should be a triangular dynamic pulse, peaking at 14g with a rise time of 0.08 seconds and a velocity change of 35 feet per second. Comments from related industries were submitted to support that position. The analysis is based on full-scale controlled crash data, and selects velocity change intervals which are claimed to represent the structural limit at which the fuselage breaks up. The FAA does not concur with the level of survivability selected by the commenter to establish his proposed pulse. While localized fuselage breakup did occur in these test airplanes, the fuselage maintained a protective shell and limited acceleration loads to a survivable level in all areas outside of the local fracture. Airplane accident experience confirms that observation and has demonstrated that localized fuselage breakup is not the limit on overall passenger survivability. Moreover, data submitted to the FAA indicate that many seats currently in service are capable of meeting the recommended 35 feet per second and 14g criteria. One commenter believes that seats designed to meet the standards proposed in the NPRM would be practical, feasible, and consistent with current floor strength levels if the seat is designed properly. Recent tests support this belief. Two commenters contend that it is unnecessary to introduce dynamic testing. They believe that the mode of load application for static testing used by the British Civil Aviation Authority should be used, together with the addition of floor deformation per proposed § 25.562(c). The FAA disagrees. Although improved static test methods could be used to evaluate the structural integrity of the seat, these methods cannot evaluate the ability of the seats to protect passengers and crewmembers from injury. Also, one commenter suggests that dynamic testing may be too complicated (dummy, HIC, two rows, cabin interior), and that a simple drop test of a seat with accelerometers, no anthropomorphic dummy, and no expensive test equipment could be used. The FAA disagrees. No simple dynamic test has been developed which will provide human-like load distribution on a seat/restraint system without using an anthropomorphic dummy. Several efforts have been made without using a dummy, but without success. Moreover, the simple test would not provide any measure of passenger injury protection.

One commenter supports the proposal, but would prefer 20g and similar dynamic tests for items of mass. Designing a seat to meet a 20g dynamic test condition without defining the velocity change and energy level associated with the dynamic pulse would not, in itself, assure a higher level of safety. Seats designed to meet the 16g and 44 feet per second criteria could also be shown to react 20g dynamic loads at an equivalent energy level. Strengthening the floor structure to carry the 20g dynamic load with a 44 feet per second change in velocity would add considerable weight to the structure and could not be shown cost effective. Static criteria are sufficient to evaluate the structural strength and retention characteristics of items of mass where occupant injury assessments are not required.

One commenter argues that specific load values of 2,250 pounds in each femur should be deleted and the rule stated in objective terms. Padding the lower rear edge of the seat is suggested as an alternative. The reason for specifying the 2,250-pound maximum allowable femur load value is to have an objective pass/fail performance criterion. It may be achieved through energy absorbing designs, including padding if appropriate, by clearance for the legs, or by whatever other designs are appropriate.

Several commenters state that more dynamic testing is needed to understand the relationships between seat pitch, bulkhead distance, strike zone from the 10-degree yaw, and the femur loads and HIC. A continuing dynamic test program at the CAMI test facility, which has had the participation of airframe and seat manufacturers, has given a better understanding of the various design parameters affecting the HIC and femur loads. Based on the results of these tests, the FAA believes these design requirements are realistic and achievable without paying an undue design penalty.

One commenter suggests that upper torso restraint for passengers to minimize secondary head impact should be considered, since a HIC less than 1000 would not ensure a conscious passenger. While a HIC of 1000 might not ensure a conscious passenger, it should prevent a fatal head injury in a serious crash. The rule does not prohibit installation of upper torso restraints; however, installation of upper torso restraint systems for passengers on transport airplanes could create significant design problems, such as structural weight penalties associated with the stronger seat back and floor structure, and shoulder straps could create entanglement problems during emergency egress. The new standards for seat performance provide a significant increase in passenger survivability during emergency landing conditions with only lap belt restraints.

Several comments were received regarding specific aspects of the test procedures and compliance criteria (pass/fail criteria, defining critical conditions, etc.). Guidance regarding test procedures, along with acceptable means of compliance, will be provided in the final release of AC 25.562-1.

Several commenters express concern that the cost analysis is inaccurate in that it underestimates the costs associated with the proposed rule. Others state that the costs are overestimated. A revised cost analysis has been prepared which reflects changes in the proposed rule and more accurate estimates of benefits and costs. The revised benefit and cost estimates improve the benefit to cost ratio from the original estimate prepared for the notice.

Several commenters are concerned about the applicability of the new seat requirements to future and current airplanes. Some believe that it should apply to the existing fleet as well as to future certification. Others express concern over possible changes to Part 121 which would make the new standards applicable to current airplanes. They are also concerned that if the Part 25 rule were adopted, they would have to use seats manufactured to meet the new standards, regardless of whether Part 121 was amended, because seats meeting current standards would no longer be produced. The FAA believes seats designed to the new performance standards could also be used in older airplanes without creating an undue economic burden. Seats meeting the new standards could be phased in during major interior modification or during refurbishment, if desired. However, the FAA will not, by virtue of this amendment, require an upgrade of the static strength standards on fixed items of mass, nor require the replacement of seats in airplanes manufactured under existing type certificates. The Airport and Airway Safety and Capacity Expansion Act of 1987 (Public Law 100-223, December 30, 1987) directs the Secretary of Transportation to initiate rulemaking to consider the retrofit on air carrier aircraft of seats that meet improved crashworthiness standards. The FAA expects to initiate such rulemaking shortly, and comments submitted in response to Notice 86-11 regarding the issue of retrofit will be considered.

The airplane manufacturers, through the Aerospace Industries Association (AIA), submitted a cost analysis covering three separate proposals. Their proposals were grouped I through III, based on cost effectiveness, and range from most expensive to least expensive. The Group I analysis was based on the erroneous assumption that the rule changes would require that the seat dynamic testing be accomplished on representative aircraft floor structure, and that the aircraft floor structure would thus have to accommodate the floor deformation specified in the rule without failure. This analysis also assumed that all the requirements proposed in the NPRM would be adopted.

The Group II analysis was based on the assumption that the seat dynamic testing would be accomplished on a test fixture, rather than on aircraft floor structure, but otherwise equivalent to the Group I assumptions. The Group III analysis was based on the assumption that the static side load factor of § 25.561(b)(3) was increased to 3.0g, an aft load factor of 1.5g was added, the seat static side load factor was 4.0g, and the dynamic test conditions for seat assembly tests were reduced. They estimate that the additional weight increase for seats designed under the Group I or Group II assumptions would be 0.6 pounds per seat, and 0.3 pounds per seat under the Group III assumptions. They estimate that there would be no airframe weight increase for the Group III assumptions. The rule, as adopted, closely corresponds to the Group III assumptions for the airframe; therefore, no significant airframe weight increase is anticipated. The rule corresponds to the Group II assumptions for seat dynamic testing, where analysis indicates a seat weight increase of 0.6 pounds per seat would be anticipated; however, seat manufacturers have indicated that seats complying with the standards proposed in the NPRM have been developed at a weight penalty of only 0.3 pounds per seat. In either case, the projected weight increase (0.9 to 1.8 pounds for a triple-seat assembly) is well within the variation of seat weight among seat models competing successfully in the current market.

Except as discussed above, the proposals in Notice 86-11 are adopted as proposed.

Regulatory Evaluation Summary

This regulatory evaluation will primarily address the passenger seat. Although the rule also prescribes standards for the flight attendant and flightcrew seats, these seats are expected to have costs and benefits that are similar to those of the passenger seat. In addition, they represent a relatively small economic impact compared to passenger seats. The airplane structure on new type designs is expected to require only minor modification. For this reason, only a negligible cost impact is anticipated.

The benefits and the costs of requiring improved seat performance are both directly proportional to the number of seats; that is, the total cost is equal to the number of seats times the cost per seat and the total benefits are equal to the number of seats times the benefit per seat. Therefore, one can calculate the relationship between benefits and costs by determining the benefits per seat and the cost per seat, and this will be the approach used in this evaluation.

Benefits

The final rule will improve the crashworthiness of transport category airplanes by revising the seat standards. Because of the improved standards, some lives are expected to be saved that otherwise may not have been.

It is difficult to determine, accurately, the potential reduction in casualty loss that may result from this rule because it involves estimating casualty loss that would occur from use of presently designed seats that would not occur from use of seats designed to the improved standards. In reviews of accidents, identification of fatalities or injuries caused by insufficient seat strength or seat attachment deficiencies is difficult because of incomplete knowledge of the crash dynamics, injury mechanisms, and survivor testimony relating to the crash. In addition, post-crash fires consume necessary data. Nevertheless, there are some data available which can offer insight into prospective benefits.

The FAA has reviewed many accidents to determine seat performance. In fact, in March 1983, the FAA published a study, "Crash Injury Protection in Survivable Air Transport Accidents—U.S. Civil Aircraft Experience From 1970 to 1978," relating to the issue of seat adequacy. As part of that study, a comprehensive data base was developed on passenger seat/restraint system performance in survivable transport category airplane accidents. The study drew the following conclusions: "Although injuries and fatalities seem to be decreasing in the more recent survivable crashes, seat performance continues to be a factor in these crashes. Failures range from seat pan collapse to complete breakaway of the seat assembly from the floor are reported. Floor or cabin deformation frequently is a cause of seat failure. Flailing injuries, due to either bending over the restraint system or secondary impact with the aircraft interior, appear to be common."

The National Aeronautics and Space Administration (NASA) and the FAA jointly sponsored parallel studies by Lockheed, McDonnell Douglas, and Boeing to identify areas of research and approaches that may result in improved occupant survivability and crashworthiness of transport category airplanes.

The Boeing study involved accidents involving international airlines as well as U.S. airlines. Boeing concluded that the aircraft strength and occupant injury tolerance appear to be in proper balance in 31 accidents in which seat performance was mentioned in NTSB reports. Douglas stated that it was premature to evaluate seat performance and recommended a test program. Lockheed stated that the results of the review of the seat performance indicate that the seats and restraint systems designed to current FAA criteria are providing a system that protects the occupant.

The FAA contracted with Simula, Inc., and RMS Technologies, Inc., to do a study of severe survivable accidents between 1970 and 1983. The study, among other things, identifies instances where an improved seat/restraint system might have been beneficial. The results of the study were published in a report titled *Crash Dynamics Program Transport Seat Performance and Cost Benefit Study*, October, 1986. The Regulatory Evaluation for the NPRM was based on the 1983 FAA study since that was the latest study available at the time. The accident data base for this Regulatory Evaluation will be based on the Simula/RMS Technologies study. This later study reviewed the previous studies, included additional accident data for the period 1979 through 1983, and more clearly related cause and effect, that is, associated fatalities and injuries with seat failure. For example, in the NPRM it was stated that there were 368 fatalities and 346 serious injuries to passengers involved in accidents where seats could have been a contributing factor over the period 1970 to 1978, whereas in the Simula/RMS Technologies study it is stated that at least 107 fatalities and 63 serious injuries had the potential of being avoided through the use of improved seats over the period 1970 to 1983.

During the fourteen year period between 1970 and 1983, there were 3,343 million passenger enplanements on U.S. air carriers. Therefore, the casualty rate where improved seats could have been of benefit is 0.0320 fatalities per million passenger enplanements (107 fatalities divided by 3,343 million passenger enplanements) and 0.0188 serious injuries per million passenger enplanements. The question arises of how effective an improved seat would have been in preventing the 107 fatalities and 63 serious injuries. In reality, the improved seats would not be 100 percent effective in preventing these deaths and injuries. In the NPRM it was estimated that the improved seat would be from 3 to 15 percent effective in preventing casualty loss of a much larger accident base, that is the improved seat would prevent from 0.00532 fatalities per million passenger enplanements to 0.0266. In reviewing the accidents discussed in the Simula/RMS Technologies study and the ability of the improved seats to match the strength and resiliency of the airplane floor, the FAA estimates that the improved seat would be at least 80 percent effective in preventing the casualty loss described in the study. The effectiveness is based on judgments made as the accident files were reviewed as to whether an injury or fatality was of the type that could have been prevented by an improved seat. It is also apparent that available accident records do not identify all seat related casualty loss. A correction for this lack of data, as indicated in the report, would more than compensate for the assumption associated with other than 100 percent effectiveness. Therefore, in this analysis the fatality rate (0.0320 fatalities per million passenger enplanements) calculated above will be used. The impact of variations in effectiveness of the improved seat will be discussed in the section on sensitivity.

To determine the benefits per seat, the number of enplanements per seat has to be developed. The FAA forecast indicates that there will be about 681,000 seats in the fleet in 1995. That year was used as the point when newly certificated airplanes would be entering the fleet. The number of enplanements for 1995 is forecast at 693.5 million. Therefore, the number of enplanements per seat per year is 1,018 (693.5 million enplanements divided by 681,000 seats). As indicated above, the fatality rate avoided as a result of improved seats is 0.0320 fatalities per million passenger enplanements. Therefore, the number of fatalities avoided per million seats per year is 32.58 (0.0320 fatalities per million passenger enplanements times 1,018 enplanements per seat per year). For the purpose of analysis, the FAA has used the statistical minimum economic value of a human life of $1 million. This is the accepted value used by economists in Government policy analysis. Using this value, the benefit per year per seat is $32.58. Because a serious injury is estimated to cost society less than 10 percent of the cost of a fatality, and the reduction in serious injuries is less than that for fatalities, serious injuries will be neglected for the purpose of comparing benefits and costs.

The service life of a seat can vary widely. Some seats have been providing service in excess of 20 years. Others are replaced because airlines want to reconfigure cabins or desire seats with lower weight or maintenance costs. For the purpose of this analysis, the service life of a seat is assumed to be 7 years. This is in contrast to the ten years used in the Initial Regulatory Evaluation for the NPRM. It is based on additional discussions with the airline industry and makes the benefit estimate more conservative. The present value of benefits per seat is about $159 (7 year life, 10 percent discount rate).

In the Initial Regulatory Evaluation for the NPRM, the number of enplanements per seat was based on historical data during the 1970s. It was brought to the agency's attention that present and prospective data indicate that seats are being used more intensely, that is, load factors are higher and airplanes are being used more hours per day. Therefore, enplanements per seat for the year 1995 is used in this analysis. Also, in the analysis for the NPRM, the prospective accident rate compared to the historical rate was reduced by one-half based on improvements being made in the aviation system. It was difficult to corroborate this by means of statistical analysis, and it will be discussed in the section on sensitivity.

Costs

This cost analysis is based on the one developed for the NPRM and the comments received in response to that document. The two basic elements of the seat cost are the increase in manufacturing cost and the cost impact of any weight increase. Seats for transport category airplanes currently cost about $1,200 and weigh about 19 to 22 pounds per passenger.

The cost for a newly designed seat consists of fixed and variable (or recurring) cost elements. The fixed costs are composed of the following:

1. Engineering design.
2. Construction of prototypes.
3. Development and certification testing.
4. Tooling and training.
5. Documentation.

The seat manufacturers became aware that the FAA was investigating the merits of introducing improved seat standards several years ago and were informed of the details of the FAA proposals with publication of the NPRM in July 1986. As a result of this knowledge, as well as their desire to offer the safest product possible, the seat manufacturers began to develop seats to the proposed standards. Similarly, the airline operators started to specify that seats must meet the proposed standards. Several seat manufacturers are already selling seats which meet the proposed standards. Therefore, development costs can be considered as sunk costs.

The variable costs or recurring costs consist of the materials, labor, and expendables used in the manufacture of the seat. The additional materials are likely to be less than 2 or 3 pounds of metal, including scrap, and thus contribute only modestly to cost. Additional labor requirements are also expected to be modest since basically the same work tasks will be done as are now. For example, the time to forge two similar but slightly different structural elements is likely to be the same. The FAA estimates the increase in fabrication costs to be about 3 percent or about $36 per seat. Of the several seat manufacturers that commented in response to the NPRM, only one made a cost estimate. That estimate was that there would be a 3 percent increase in sales price as a result of the new standard. This is less than the FAA estimate since it includes all costs, both fixed and variable.

The increase in weight of the structure that is expected to result from this rule cannot be determined with any certainty. The FAA estimates the weight increase to be 0.6 pounds. Estimates from the seat manufacturers in response to the NPRM ranged from 0.3 pounds to 1.5 pounds per seat. Each pound of weight increase can result in 15 gallons of additional fuel burn per year. At 60 cents per gallon, the weight increase would cost $5.40 per year (i.e., 0.6 pounds weight increase times 15 gallons per pound times $.60 per gallon).

The annual seat cost is developed by annualizing the seat fabrication cost over a seven year period and adding it to the annual fuel cost. The annual seat cost is $12.79. The present value seat cost is $62.29.

The FAA expects that, with the exception of seats, there will be no significant modification of the airplane structure, its interior furnishings, or the seat restraint systems, such as seat belts, as a result of the rule. The FAA therefore estimates that there will be only negligible additional costs for these items. Several commenters questioned this estimate, and their comments were addressed in the section "Discussion of Comments."

Comparison of Benefits and Costs

As indicated in the section on benefits, the present value of benefits per seat is $159; the costs are about $62, yielding a benefit to cost ratio of 2.6.

Sensitivity

As stated previously, there is some uncertainty with respect to the FAA estimates of costs and benefits. The critical estimates are discussed below.

Life of Seat. In this analysis, it was estimated that the life of a seat is seven years. There is a greater probability that the life of a seat is greater than seven years rather than less. If, for example, the life of a seat were 10 years, the benefit to cost ratio would be 2.9 compared to 2.6.

Effectiveness of Seat. In this analysis, improved seats were estimated to be highly effective in preventing fatalities in which seats were judged to be the cause. It is recognized that the seats will not be 100 percent effective, but on the other hand, the Simula/RMS study stated that there were additional fatalities, due to seats, that could not be identified. In light of these two unquantifiable, off-setting factors, the FAA used the Simula/RMS numbers without adjustment. The FAA assumed that, had the improved seats been installed during the period studied by Simula/RMS, 107 lives could have been saved. The FAA also assumed a linear relationship between the effectiveness of the improved seats and the number of fatalities prevented. If, for example, the improved seat prevented only half of the fatalities estimated, the benefit to cost ratio would be 1.3 rather than 2.6.

"Value" of a Life. The "value" of a life is open to much debate and much has been written in the literature on that subject. The FAA uses $1 million for the "value" of a life for analysis purposes. The benefit to cost ratio will vary directly with the value, that is, if the value were $2 million, the benefit to cost ratio would be 5.2 rather than 2.6. The value must be at least $385,000 for a benefit to cost ratio greater than one, in this analysis.

Future Accident Rate. The accident data for this analysis covered the period 1970 through 1983. The prospective accident rate in this analysis was assumed to be the same as in that period. Since accidents are relatively rare events, a single accident can change trends. If it is assumed that the prospective accident rate will be 50 percent of the historical rate, the benefit to cost ratio will be 1.3 rather than 2.6.

Cost of a Seat. The cost of a seat is made up of two elements, the sales price and the cost impact of any weight change. The present value of the sales price and of the weight change (0.6 pound) are $36 and $26, respectively. If the weight change were 1.2 pounds rather than 0.6 pounds, the benefit to cost ratio would be 1.8, and if the sales price were increased $72 rather than $36, the benefit to cost ratio would be 1.6 rather than 2.6. If both the weight and price were to double, the benefit to cost ratio would be 1.3 rather than 2.6.

Trade Impact Assessment.

The rule will have little or no impact on trade for both U.S. firms doing business in foreign countries and foreign firms doing business in the United States. Foreign firms seeking U.S. approval for their products must also meet the new standards. Most likely, the foreign airworthiness authorities will impose similar standards on products, of whatever origin, approved in their countries. Therefore, there should be no competitive advantage to anyone. There were no comments with respect to trade impact.

Regulatory Flexibility Determination.

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by Government regulations. The RFA requires agencies to review rules which may have "a significant economic impact on a substantial number of small entities."

This rule amends 14 CFR Part 25. Part 25 prescribes airworthiness standards for the issue of type certificates for transport category airplanes. The FAA size threshold for a determination of a small entity for aircraft manufacturers is 75 employees; that is, an aircraft manufacturer with more than 75 employees is considered not to be a small entity. The manufacturers of transport category airplanes such as Boeing, Gates Learjet, and McDonnell Douglas, are all large manufacturers. Therefore, it is clear that this rule does not impact small entities. There were no comments relating to the impact on small business.

Additional Information.

Additional information relating to the regulatory evaluation is contained in a more detailed evaluation which is available in the docket.

Federalism Implications.

The regulations set forth in this amendment are promulgated pursuant to the authority in the Federal Aviation Act of 1958 (Act), as amended (49 U.S.C. 1301, *et seq.*), which statute is construed to preempt state law regulating the same subject. Section 601(a)(1) of the Act empowers the Administrator of the FAA to promote safety of flight of civil aircraft in air commerce by prescribing minimum standards governing the design, materials, workmanship, construction, and performance of aircraft. Thus, in accordance with Executive Order 12612, it is determined that such regulations do not have federalism implications warranting the preparation of a Federalism Assessment.

CONCLUSION: For the reasons given earlier in the preamble, the FAA has determined that this is not a major regulation as defined in Executive Order 12291. In addition, the FAA certifies that this rule does not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none are affected. Since this regulatory document concerns a matter on which there is substantial public interest, the FAA has determined that this document is significant as defined in Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979).

Adoption of the Amendment

Accordingly, Part 25 of the Federal Aviation Regulations (FAR), 14 CFR Part 25, is amended effective June 16, 1988.

The authority citation for Part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983); and 49 CFR 1.47(a).

Amendment 25-65

Cockpit Voice Recorders (CVR) and Flight Recorders

Adopted: June 30, 1988 **Effective: October 11, 1988**

(Published in 53 FR 26134, July 11, 1988)

SUMMARY: The FAA amends its regulations to require digital flight data recorders and cockpit voice recorders (CVRs) to be installed in a broad category of airplanes and rotorcraft operated by air carriers and commuters, as well as in selected aircraft operated in general aviation. The amendments are in response to legislation which mandates the FAA to amend its flight recorder and CVR requirements in accordance with recommendations from the National Transportation Safety Board (NTSB). The intent of this rulemaking is to provide more information to accident investigators in determining the causes of accidents and the measures needed to correct the causes. In addition, the FAA also requests additional comments regarding the general aviation requirements.

DATES: *Effective date:* October 11, 1988.

Comments on the Part 91 requirements must be submitted on or before October 11, 1988.

Compliance Date: October 11, 1991.

ADDRESSES: Comments on the Part 91 requirements should be mailed in triplicate to: Federal Aviation Administration, Office of the Chief Counsel, Attention: Rules Docket (AGC-10), Docket No. 25530, 800 Independence Avenue, SW., Washington, DC 20591. Comments delivered must be marked Docket No. 25530. Comments may be examined in Room 915G weekdays between 8:30 a.m. and 5 p.m., except on Federal holidays.

FOR FURTHER INFORMATION CONTACT: Frank Rock, Technical Analysis Branch (AWS-120), Aircraft Engineering Division, Office of Airworthiness, Federal Aviation Administration, 800 Independence Avenue SW., Washington, DC 20591; Telephone (202) 267-9567.

SUPPLEMENTARY INFORMATION:

Background

The FAA issued a notice of proposed rulemaking on flight recorder and CVR requirements on February 12, 1988 (Notice No. 88-1, 53 FR 4314). The proposed rule was primarily based on recommendations from the NTSB issued on June 19, 1987. FAA rulemaking on these requirements was mandated by legislation on December 22, 1987, in the Appropriations Act, 1988, (Pub. L. 100-202) and on December 30, 1987, under the Airport and Airway Safety and Capacity Expansion Act of 1987, Title III, Section 303(c) (Pub. L. 100-223).

The Appropriations Act required the FAA to expand existing CVR and flight recorder requirements "to smaller sizes of commuter air carrier aircraft" and to require CVR and flight recorder "retrofits on certain types of existing commuter air carrier aircraft. . . ."

The Airport and Airway Safety and Capacity Expansion Act required the FAA to initiate rulemaking "to consider the use of cockpit voice recorders and flight data recorders on commuter aircraft and other aircraft, commensurate with the recommendations of the National Transportation Safety Board."

The NTSB issued its safety recommendations in response to a number of significant events which had occurred since its previous recommendations issued in August 1982. These events were FAA's flight recorder and CVR rule changes issued March 25, 1987; the technological development of solid-state flight data recorders (SFDR); the continued growth of the commuter air carrier industry; revisions to Part 23 of the Federal Aviation Regulations (FAR) (14 CFR Part 23) which defined a commuter category airplane and established certification requirements for commuter category airplanes; and the adoption by the International Civil Aviation Organization (ICAO) of revised flight recorder and CVR standards.

The FAA used the NTSB recommendations of June 19, 1987, as an appropriate background to discuss extending and updating its flight recorder and CVR rules. The rules on CVR and flight recorders had been last amended March 25, 1987 (Amendment Nos. 91-199, 121-191, 125-8, 135-23; 52 FR 9622). In simplified terms, the 1987 amendments required that FAR Part 121 operators update certain of their airplanes over a specified time period with digital flight recorders that have 6, 11, or 17 data parameters depending on the date of type certification or manufacture. Parts 91 and 125 were also amended by requiring that any operator who has installed approved flight recorders and approved CVRs shall keep the recorded information for at least 60 days after an accident or occurrence requiring immediate notification to the NTSB. The 1987 amendments extended Part 135 voice recorder requirements which applied to any turbojet airplane having a passenger seating configuration of 10 seats or more to any newly manufactured multiengine, turbine-powered airplane that was certificated to carry six or more passengers and required to have two pilots. The 1987 amendments did not require flight recorders for operations conducted under Part 135. They did not require voice recorders or flight recorders for operations conducted under Parts 91 and 125. They did not require flight recorders for helicopters.

The NTSB wanted broader application of the requirements than those established in the 1987 amendments, and the NTSB recommended that the requirements, including parameter requirements, be updated to cover technological improvements in CVR and flight recorder equipment. Through the aforementioned legislation, Congress agreed.

As stated in the preamble to the proposed rule and in the NTSB recommendations, the need for updated and expanded regulations on the installation and use of flight recorders and voice recorders is twofold. First, technological advances in cockpit equipment have greatly increased the potential for accumulating information on the flight characteristics of an aircraft at the time of an incident or accident. However, unless aircraft equipped with new electronic display systems (i.e., "glass cockpits") are also equipped with flight recorders that can capture the flight information and from which investigators can retrieve that information, the information is lost. Therefore, a major objective of this rulemaking is to upgrade the parameters and flight recorder and voice recorder standards to accommodate the most sophisticated systems now being installed in aircraft. Secondly, previous flight recorder and voice recorder requirements have not been applied to significant sectors of air transportation operations.

In recent years the commuter air carrier fleet has grown substantially and its growth is expected to continue. The 1987 annual report of the Regional Airline Association (whose membership consists primarily of commuter air carriers) estimates that more than 61 million passengers will be carried by members of that association in 1997. The growth in commuter air transportation has resulted in newly manufactured aircraft designed specifically for the commuter market. While these new airplanes have a take-off weight in excess of 12,500 pounds, they often have a seating configuration of less than 30 passenger seats and payloads of 7,500 pounds or less, which means they are operated under Part 135. Until now Part 135 has had no flight recorder requirements. Therefore, vital accident data from commuter airline accidents has not been available.

The NTSB safety recommendation cites several recent commuter air carrier accidents in which investigations revealed a lack of information that would have been pertinent to determining the causes. Although the investigations produced a number of safety recommendations based on evidence of potentially hazardous conditions and practices, the specific flight crew actions or inactions, environmental conditions or equipment failures that may have caused the accidents could not be positively determined. Therefore the NTSB's safety recommendations towards preventing recurrence could not be as definitive as possible. The NTSB has indicated that in these accidents if flight recorder information had been available, specific deficiencies in flight crewmembers performance or mechanical failures or malfunctions could have been determined. Without flight recorder information, accident investigators are severely limited in definitively assessing causes. Therefore, the FAA has added flight recorder requirements to Part 135 and extended the voice recorder requirements in Part 135 to specific types of airplanes and rotorcraft.

Part 91 and Part 125 operations have had neither flight nor voice recorder requirements. The lack of information poses the same problem to investigators as in commuter operations. Therefore, this rulemaking extends flight recorder and voice recorder requirements to specific types of airplanes and rotorcraft being operated under Part 91 and specific types of airplanes operated under Part 125.

In addition to the above, the NTSB recommended that all newly manufactured aircraft and new cockpit voice recorder installations be designed to allow for uninterrupted recording from boom or mask microphones and headphones for each flight crewmember station and from an area microphone on dedicated channels of the CVR. The performance of CVR installations of this kind where the audio signal of each crewmember station is continuously recorded on a dedicated channel provides much clearer recorded information for investigators than the standard cockpit area microphone (CAM). Therefore, this rulemaking includes amendments to Parts 23, 25, 121, 125, and 135, to require the NTSB recommended capability on newly manufactured aircraft and on aircraft on which new cockpit voice recorders are installed and to require the use of that capacity where it already exists.

In the interest of safety and in accordance with the Congressional mandate and NTSB recommendations, the FAA is extending and updating its regulations in flight recorders and voice recorders. This action is consistent with the requirements of § 601(b) of the FA Act that the FAA perform its powers and duties ". . .in such manner as will best tend to reduce or eliminate the possibility of, or recurrence of, accidents. . . ."

Overall this rulemaking accomplishes the following significant changes:

(1) It establishes flight recorder requirements for certain aircraft operated under Parts 91, 125, and 135.

(2) It establishes cockpit voice recorder requirements for certain aircraft operated under Parts 91 and 125, and extends and revises voice recorder requirements under Part 135.

(3) It upgrades the requirements and parameters for flight recorders to the level of the most sophisticated systems installed in aircraft. The new parameters and requirements affect certain aircraft operated under Parts 121, 125, and 135.

(4) It requires uninterrupted sound recording capability in cockpit voice recorders under Parts 23 and 25 and specifies use of this capacity under the operating rules of Parts 121, 125, and 135.

(5) It revises CVR and flight recorder airworthiness standards in Part 25; establishes flight recorder installation requirements in Parts 23, 27, and 29; and establishes CVR requirements in Parts 23 and 27.

COMMENT DISCUSSION

The FAA received 52 comments on the NPRM. Thirty-one comments opposed the proposed rule; nine supported it; two supported it with reservations.

The rest of the comments did not express opposition or support. At least 19 comments addressed specific issues raised by the proposed rule. The categories of commenters included airport authorities, state governments, operators of airplanes and helicopters, manufacturers, and foreign air transportation companies. Of the associations representing air transportation interest groups, comments were received from the Air Line Pilots Association (ALPA), the Air Transport Association (ATA), General Aviation Manufacturers Association (GAMA), Airport Operators Council International, the National Air Transportation Association (NATA), and the Regional Airlines Association (RAA). Commenters who opposed the rule were primarily operators conducting operations under Part 135 (or Part 91), particularly operators of helicopters, as well as ATA and NATA. Categories of commenters supporting the rule were manufacturers, state governments, and airport authorities, the National Transportation Safety Board (NTSB), and the RAA.

Several commenters presented recommendations and raised concerns over specific requirements in the rule. The following categories of issues were raised and are discussed separately below:

(1) Part 121 requirements

(2) Part 91 and Part 135 requirements

(3) Specific technical requirements

(4) Comments beyond the Scope of the Notice.

Part 121 Requirements

The Air Transport Association (ATA) on behalf of its member airlines submitted a number of objections to the proposed changes in Part 121 and in some cases to the proposed parallel changes in Part 25. Several of ATA's objections were also raised by other commenters. Overall opposition to the proposed changes was based on two general arguments. First, the ATA argued that the Congressional language cited in the NPRM as a primary basis for the proposed changes did not identify

Part 121 air carriers. Second, they argued that "the NTSB and FAA have not adequately justified the Part 121 proposals for further expansion of flight recorder requirements beyond those in Amendment 121-91." ATA also stated that the 45-day comment period was too short for its member airlines to "provide the type of technical and economic impact information needed to develop final credible technical and cost analyses," and recommended that the FAA withdraw and reconsider the proposed amendments to Parts 25 and 121.

ATA and others specifically commented on technical concerns with Part 121 proposals. Comments of a purely technical nature are dealt with elsewhere in this preamble. The remaining Part 121 comments (mostly from ATA) are summarized as follows:

- Of the six new developments cited by FAA in Notice 88-1 as justification for the proposed additional requirements, none justify the proposed Part 121 changes.
- Notice 88-1 did not include any discussion on "major rule", "significant rule" requirements under Executive Order 12291 and DOT policy, respectively.
- There are significant differences between the FAA/NTSB proposed flight recorder parameters and the ICAO standards which ATA says are "recommended standards only" which are "in the process of being revised."
- Adoption of 32 parameter flight recorder requirements for newly manufactured airplanes rather than last year's requirement for 17 parameter flight recorder for newly manufactured airplanes will create an unnecessary administrative and logistics burden.
- The proposed additional parameters could exceed the capacity of digital flight data acquisition units "denying airline use of flight recorder information for routine maintenance and operations analyses, some of which are required by the FAA."
- The relationship of the proposed requirements to the rules adopted in Amendment 121-191 is confusing and potentially disruptive and costly to airline operations especially when considered with other FAA requirements already adopted or under consideration (e.g. windshear, TCAS requirements). Related to this ATA comment was a comment by McDonnell Douglas Aircraft Co., which indicated that changing "regulatory requirements on systems such as flight recorders on an annual basis . . . makes planning very difficult and expensive."

ATA offered an alternative to the FAA proposal. ATA suggests that for a retrofit, additional parameters be required only when the airplane is already equipped with "an ARINC 717 digital flight data acquisition unit (DFDAU) with the ARINC buses containing the (a number to be later determined) additional parameters *already* converted to it." For newly manufactured airplanes ATA would follow the same pattern except that additional parameters above the 17 parameters of Amendment 121-191 would be recorded "on a space availability basis without impacting existing airline recording programs. . . ."

The FAA's Response:

The FAA does not agree with ATA's interpretation of the Congressional mandate. Given the overall legislative history of Public Law 100-223, FAA believes that the Congressional intent is to ensure safety by making available to the NTSB whatever data is necessary for accident investigation if acquiring that data is technologically feasible. Congress stated this intent by ordering the FAA "to initiate a rulemaking proceeding to consider the use of cockpit voice recorders and flight data recorders on commuter aircraft *and other aircraft, commensurate with the recommendations of the National Transportation Safety Board.*" (Emphasis supplied.) In its June 19, 1987, letter to the FAA, the NTSB stated its requirements which covered 14 CFR Parts 23, 25, 91, 121, and 135. FAA proposed to meet those requirements in Notice 88-1, as directed by Congress. Comments submitted by the Board did not indicate that the proposed Part 121 requirements exceeded the bounds of what the Board determines as necessary information for conducting accurate accident investigations.

ATA is correct that the normal paragraph addressing "major rule" under Executive Order 12291 and "significant rule" under DOT policy was omitted - inadvertently - from the NPRM. Nonetheless, the potential costs were fully discussed in the preamble (and in a full economic evaluation in the docket) and the substance of that discussion indicated that the proposed rule would not be considered major under the Executive Order. Further, the overall preamble discussion made it clear that the proposals were significant within the meaning of the Department of Transportation's Regulatory Policies and Procedures.

The 1987 Amendments to Part 121 did not increase the parameters listed in Appendix B of that part. NTSB has stated in its recent recommendations that Appendix B should be updated to expand the parameters list and define new parameters, improved accuracies, ranges, and sampling intervals so that flight recorder standards are consistent with the capabilities of the most advanced electronic display systems. As stated by NTSB, "The introduction of the Airbus A320 with its fly-by-wire technology will present new challenges in accident investigation that will require post accident information of the quantity and quality that goes far beyond the current minimum standards of Appendix B."

In response to the NTSB recommendations, this rulemaking updates the parameter list to meet the requirements of the most advanced cockpit systems if installed and to require the best available flight recorder technology for newly manufactured airplanes operated under Part 121. The requirement for flight recorder parameters in addition to the 17 required by the 1987 amendments applies only to aircraft manufactured after October 11, 1991, or those already equipped with specific ARINC equipment. This allows adequate time for the required installation of the latest flight recorder equipment as part of the manufacturing process which should cause no manufacturing delay and only minimal cost.

While ATA describes the proposed tie-in with existing ARINC 429 equipment (or an equivalent) as a retrofit requirement, it is not the normal mandatory type retrofit requirement applicable to all or certain specified airplanes operated under Part 121 or Part 135. The final rule clarifies the FAA intent in this regard (discussed under Technical Comments portion of this preamble) and as adopted the rule will apply only where stated equipment is already installed in an airplane and where data is readily available so that it can be accessed with virtually no burden on Part 121 operators, either in lost airplane time or other costs.

In consideration of other objections raised by ATA, that extending the parameters from 17 to 32 (or higher, by ATA's count) is too great a change too soon, that Part 121 operators are being required to make other equipment changes at the same time, and that the proposed parameters were not consistent with those recommended by ICAO, and in consideration of the comments submitted by the NTSB, the FAA has done the following: (1) extended the effective date of the requirements to 3 years instead of the proposed 2 years; and (2) reduced the number of mandatory parameters to 28 and made the other highly desired parameters optional where feasible.

Parts 91 and 135 Requirements

Except for the Regional Airline Association's agreement with most of the proposed Part 135 amendments, virtually all of the operators who commented on these requirements opposed them. Specific technical comments are discussed below. Typical of the more general opposing comments was the comment of the North Dakota Aviation Council which stated that the FAA had "expanded the intent of Congress" in proposing CVR and flight recorder requirements for certain general aviation operations under Part 91 and on-demand operations under Part 135. The National Air Transportation Association (NATA) also accused the FAA of expanding the Congressional mandate and further stated that nowhere in the proposal "can a case be made for a quantitative increase in safety benefit for requiring CVR's in the types of aircraft typically operated in the Part 135 charter fleet."

One commenter pointed out that a 2-year compliance period for the installation of CVR's is inadequate. From the commenter's viewpoint, most of the affected aircraft require a "heavy" inspection only every 5 to 6 years. It is during this inspection that it would be most appropriate to install the CVR.

Several commenters asserted that where an aircraft is newly manufactured to a type design of long standing, the attributes and operational history are already well known and it is unlikely that the NTSB will obtain the kind of information it seeks from accident investigations. These commenters also asserted that the past safety record did not justify the new requirements and that because of the nature of on-demand and general aviation operations the costs are disproportionate since they cannot be spread out over thousands of flight hours or hundreds of thousands of passengers boarded each year.

Some of the most vigorous comments adverse to the proposed requirements were received from helicopter operators. They, too, thought that the FAA had exceeded the Congressional mandate, that none of the cited accidents or other justification involved helicopters, and that the potential costs for helicopter operators far exceeded any potential benefits to the overall aviation industry.

The Regional Airlines Association stated that there is no justification for requiring retrofit of the 32-parameter flight data recorder on 20-30 seat airplanes under Part 135 when no such retrofit requirement was proposed for Part 121. RAA indicated that while the costs would be substantial, it could not provide specific estimates because they would vary from airplane to airplane depending on the amount of wiring already installed in the airplane.

The FAA's Response:

As discussed previously, the FAA does not agree that it has exceeded the Congressional mandate or that the new CVR and flight recorder requirements for Part 91 operators and for non-scheduled Part 135 operators cannot be justified. Accident investigators face the same problems in determining the causes of accidents, whether the accidents involve scheduled commuter operations, nonscheduled operations, or general aviation operations. New airplanes used in all of these operations employ state-of-the-art avionics and control systems; yet operators have not been required under Parts 91 and 135 to install flight recorders which would provide data to accident investigators. Post accident documentation, such as switch and instrument positions, that have proven vital in past investigations is not available with the new systems, thus increasing the difficulty in determining the cause of an accident.

Furthermore, many airplanes of the same type are used in Part 91 operations and in Part 135 operations. Therefore, any accident data collected from an accident of one of these airplane types has application for operations conducted under both parts. Also, an individual airplane may be used in operations conducted under both parts. If an airplane is used in operations under both parts, the Part 91 requirements would not be as burdensome as suggested by some commenters since in many cases the airplane would already be subject to Part 135 requirements. Also, because of the potential for use of an airplane type under both Parts 91 and 135, the used aircraft market ultimately benefits when airplanes are equipped so that they can move back and forth between different operating rules.

Accidents cited in the NPRM (which included operations conducted under Parts 91 and 135) illustrate the problems accident investigators encounter when aircraft are not equipped with flight or voice recorders. In such cases, investigators rely on interviews with fellow crewmembers, training records, FAA surveillance, cockpit standardization, and additional operational factors. Although the cause of an accident may be determined through these investigative efforts, the process may be long and costly in terms of lives and property. Time may be critical, particularly if the cause of an accident is an airworthiness factor.

The rule does recognize differences in accordance with the seating capacity of the aircraft. In Part 91, flight recorders are required for aircraft (both fixed-wing and rotorcraft) having a passenger seating configuration of 10 or more manufactured after October 11, 1991. The flight recorders must have 17 required parameters for airplanes and 22 for rotorcraft. In Part 135, flight recorders are required for aircraft (both fixed-wing and rotorcraft) having a passenger seating configuration of 10-19 seats that are brought onto the U.S. register after October 11, 1991. The flight recorders must have 17 parameters for airplanes and 22 for rotorcraft. In effect, Part 91 and Part 135 flight recorder requirements for these size aircraft apply only to newly manufactured aircraft. No retrofit of existing U.S. registered aircraft of this size is required for flight recorders.

In Part 135, airplanes having a passenger seating configuration of 20 to 30 seats and rotorcraft having a passenger seating configuration of 20 or more seats must be equipped with flight recorders after October 11, 1991. This is a retrofit as well as a requirement for newly manufactured aircraft. The NTSB in its comment agreed that it might be impractical to require 20-30 passenger airplanes to be retrofitted with 32 parameter flight data recorders, as proposed. In light of all the information received, the FAA has changed § 135.152(b) to require that affected aircraft be retrofitted with either 11-parameter or 17-parameter flight recorders (depending on the type certification date), except that those airplanes manufactured after October 11, 1991, must be upgraded to 28 parameters.

Clearly the flight recorder requirements for the larger aircraft being operated under Part 135 are more stringent than those for the smaller aircraft. Most, if not all, nonscheduled operations conducted under Part 135 use aircraft with a passenger seating configuration of less than 20 seats. Such aircraft are not required to be retrofitted with flight recorders. However, they are required to be equipped with voice recorders. Since the cost of installing voice recorders is substantially less than that of flight recorders, the FAA does not expect the voice recorder requirements to impose a significant burden on small operators.

With regard to comments about the inadequacy of a 2-year period to reasonably accomplish the Part 91 retrofit of CVR's, the FAA concurs. Accordingly, the FAA has provided a 3-year period to effect this retrofit. Recognizing, however, that some operators may not conduct a "heavy" inspection or overhaul in this period, the regulatory language provides that the Administrator, for good cause, may authorize extension of the compliance time to accommodate such maintenance schedules. A request for extension of the compliance time must be accompanied by a demonstration of good cause and must specify a date for the operator's completion of the retrofit of the CVR.

Technical Comments

A number of commenters provided detailed comments on the technical aspects of the new rules. Any such comments that address the substance of the rule are discussed below. Comments that point out printing errors, suggest non-substantive minor language changes, or suggest changes to make the rules internally consistent were considered and the appropriate changes were made. However those changes are not discussed in detail.

A number of commenters pointed out that, although the preamble to Notice 88-1 specifically discusses a new requirement for "hot mic" recording, the rule language specifies types of microphones but does not contain a "hot mic" requirement. Suggestions for appropriate rule language were provided. To correct this omission in the final rule, §§ 23.1457(c)(5) and 25.1457(c)(5) have been added to make it clear that all sounds received by the microphone must be recorded without interruption. In addition, §§ 121.359(e), 125.227(e), and 135.151(c) have been changed to clarify that §§ 23.1457(c)(5) and 25.1457(c)(5) apply to airplanes manufactured after October 11, 1991, and to airplanes on which a new cockpit voice recorder has been installed after October 11, 1991. One commenter stated that proposed § 25.1459(e) is unnecessary. This new paragraph requires evaluation of novel or unique design or operational characteristics of new aircraft to determine if additional parameters should be recorded on the flight recorder for that aircraft. The commenter is correct that additional parameters could be proposed as Special Conditions for that aircraft. However, the language is being inserted into § 25.1459 as a rule of general applicability so that as part of a review of airworthiness requirements for initial certification, a review to assess the need for additional parameters will be conducted.

A commenter pointed out that, while proposed § 91.35(b)(1) requires aircraft manufactured after one year after the effective date to be prewired to accept any appropriate flight recorder, the proposed language does not specify the date by which such aircraft must be equipped with flight recorders. The FAA has reviewed proposed 91.35(b)(1) and a parallel requirement proposed in § 135.152(a) and has concluded that, even though the requirement might provide an economic incentive to manufacturers to begin equipping airplanes to accept flight recorders, the safety benefit comes from the installation of the recorders. Therefore proposed §§ 91.35(b)(1) and 135.152(a) have not been included in the final rule.

One commenter questioned the justification for applying the proposed rules to helicopters. This commenter proposed that if CVR and flight recorder requirements are applied to any helicopters, they should be applied only to large helicopters. The FAA does not agree that the large/small dividing line (small = 12,500 pounds or less maximum certificated takeoff weight) is the appropriate determining factor for requiring or not requiring CVR and flight recorder equipment. As with airplanes, the FAA considers passenger seating configuration a more meaningful measure of the need for requiring safety information collection devices such as CVR and flight recorders.

A number of commenters stated that the language of proposed §§ 121.343(e) and 125.225(c) does not accomplish the objective stated in the preamble to Notice 88-1. Some commenters stated that the proposed rule language "equipped with an ARINC 429 digital data bus" is itself inaccurate. Others stated that even if an airplane does have the ARINC 429 equipment, that equipment may be used in such a way that it would not, without a major retrofit, provide access to the information in the additional parameters as suggested in the NPRM. The FAA's intent in following through on this NTSB recommendation was to take advantage of the full capability of more advanced technology equipment when that equipment is already installed. There is no intent to require any retrofitting costs beyond the minimal cost of accessing readily available data. The final rule has been redrafted so that it clearly carries out the original intent. It now states that when a large airplane is equipped with a digital data bus and ARINC digital flight data acquisition unit or equivalent the airplane must be "equipped with one or more approved flight recorders that utilize a digital method of recording and storing data and a method of readily retrieving that data from the storage medium." The rule, as adopted, also clarifies that only those parameters "available on the digital data bus" must be recorded.

As mentioned previously, the ATA and several other commenters questioned the number of new parameters that would be required under Appendix B to Part 121 for newly manufactured aircraft. Commenters suggested that there were inconsistencies between the FAA's proposed parameters, NTSB's recommended parameters, and ICAO recommended standards. Commenters also indicated that to meet the FAA proposed requirement would in many cases overload the system so that operators would have to sacrifice present usage of flight recorder systems to provide them with important safety-related, day-to-day operating information. At the same time some commenters suggested additional parameters, not proposed, that normally would be considered beyond the scope of this rulemaking. In order to establish standards that most effectively use flight recorder capability, the FAA has decided to require 28 mandatory parameters under Part 121, Appendix B, Part 125, Appendix D, and Part 135, Appendix D for newly manufactured aircraft. The remaining parameters will be optional, to be accessed if the operator's system has adequate capacity. The non-mandatory parameters include additional parameters that were not proposed, such as TCAS, which were added at the recommendation of the NTSB.

The NTSB and other commenters raised questions concerning the adequacy of existing Technical Standard Orders (TSOs) for both cockpit noise recorders and flight recorders. While TSOs are necessarily relevant, they have not been made a part of this rulemaking. As part of its ongoing TSO program, the FAA will revise TSOs when changes are needed to upgrade the specifications for equipment required by this final rule. These efforts are already underway and are being coordinated with the Society of Automotive Engineers (SAE) and European Organization for Civil Aviation Electronics (EUROCAE).

Some commenters pointed out that the minimum 15-minute duration period for cockpit voice recorders proposed for § 91.35(e) is not consistent with the standard agreed to in Europe (EUROCAE). Others noted that proposed §§ 91.35(b)(2) and 135.152(b) would allow a flight data recorder with an 8-hour duration while the international community is considering a 10-hour minimum to be consistent with the current ICAO recommended practice. While the FAA recognizes that both proposed limits are less stringent than those mentioned by commenters (and less stringent than FAA's own minimums under Part 121), the FAA's intent is to apply CVR and flight recorder solid state technology and CVR and flight recorder requirements to general aviation operations at minimal cost. Since the technology is already available, the FAA anticipates that reasonably priced CVR and flight recorder equipment for general aviation aircraft will be available for installation well within the 3-year compliance period allowed in this rule.

One commenter objected to the requirement in proposed Appendix E to Part 135 that a rotorcraft with over 20 passengers have flight recorders with a 24-hour recording capacity. The commenter stated that most rotorcraft operate essentially short-haul journeys and that, therefore, an 8 to 10-hour capacity should be adequate. The FAA agrees, but no change is needed since Appendix E does not require a 24-hour recording capacity. In Appendix E, the recorded time requirement is not related to the time of individual flights, but to a 24-hour clock.

Several commenters objected to the requirements in §§ 121.359(e), 125.227(e), and 135.151(c) that when operating aircraft equipped to record uninterrupted audio signals received by a boom or mask microphone, flight crewmembers must use the boom microphone below 18,000 feet. Specific objections were as follows:

(1) The requirement would make better sense elsewhere in Part 121 where it would clarify that the boom microphone rather than the handheld microphone should be used when cockpit workload is high.

(2) Flight crewmembers might not be able to determine whether the CVR in a particular aircraft has a "hot mic" feature.

(3) It requires the boom microphone even though the smoke/oxygen mask microphone might be more appropriate.

(4) It would have an impact on those aircraft which have a separate hand microphone for the public address/cabin interphone systems.

(5) Hot boom microphones are not needed since acceptable recordings are provided by directional fixed mikes and high quality area mikes.

(6) The requirement could affect flight safety by causing fatigue on flight schedules with successive short stops.

The FAA does not agree that area microphones provide recordings that are equal to boom microphones. Boom or mask microphones with uninterrupted signals produce the most audible recordings. The purpose of the requirement is to require boom microphones (or smoke/oxygen mask microphones if needed) at times when the continual recorded information would be most useful if an accident or incident occurred. Flight crewmembers should be able to tell whether CVR in a particular aircraft has a "hot mic" feature. The use of the boom microphone is not likely to be a cause of flight crewmember fatigue in short hop schedules. The causes of such fatigue are well documented—airport congestion, low altitude weather, the number of arrivals and takeoffs—factors which create a need for the use of hot mics. The requirement should not affect public address/cabin interphone communications which have a dedicated channel.

GAMA stated that except for the longitudinal acceleration and stabilizer trim position or pitch central position parameters, proposed Appendix D of Part 91 and Appendix B of Part 135 are consistent with Aerospace Standard AS 8039 which was produced by a Society of Automotive Engineers (SAE) committee formed at the suggestion of the FAA and other government agencies. The committee had concluded that the value of the potential information from the two excepted parameters would not justify the cost. GAMA also pointed out that the recommendation of the SAE committee had been unanimous except for the NTSB representative. The FAA has determined that these two parameters are justified, since the NTSB in its June 19, 1987, letter stated a need for the information that would be provided by these additional parameters.

One commenter objected to the requirement in § 91.35(d)(2) that the CVR be operating during the checklist action. The requirement would pose a problem for small aircraft that have no external source of power and that would have to rely on battery power to operate the CVR. The commenter stated that for some aircraft this would be impractical. The FAA does not agree that the requirement would be impractical. It is essential that checklist actions be recorded since in the event of an accident, investigators must determine if the checklist action was properly conducted. Determining the adequacy of the power source is a certification procedure and thus the manufacturer or operator would have to show during the certification process that CVR operation would not interfere with emergency or other power needs. This showing should not impose any significant additional burden since airplanes of the size to which this requirement applies would either operate off of an auxiliary power source or have adequate backup power available.

One commenter objected to the "Resolution Readout" column which was added to Appendix B—Airplane Flight Recorder Specifications. According to the commenter, these specifications increase resolution requirements beyond the capability of equipment currently being used. The commenter states that "Compliance with the higher orders of resolution will require more complicated software in the recorder system and in the readout equipment, effectively making all current equipment obsolete."

The resolution readout column is included to make the FAA flight recorder appendices consistent with the proposed ICAO recommended standard. However, the resolution readout requirement is intended only for flight recorder equipment installed on newly manufactured airplanes. The final rule has been changed to make this clear by including a footnote to this column in each flight recorder appendix. Also, the new TSO for flight recorder standards will contain resolution requirements.

Comments Beyond the Scope of the Notice

The FAA received several comments which were recommendations or suggestions for considering alternatives or additions to the proposal. Some of these were requests that are beyond the scope of the notice while others appeared to be primarily informational. These types of comments are summarized below and responded to.

Two commenters requested that the rulemaking update maintenance requirements to cover flight recorders and cockpit voice recorders. The FAA does not consider that a specific amendment is needed in this regard because an air carrier's continued airworthiness maintenance program will automatically cover such equipment.

One commenter requested that the cockpit voice recorder requirements under Parts 91 and 135 include a requirement for underwater locator beacons to aid retrieval of the recorders from lakes and rivers. This requirement already exists for aircraft certification requirements.

One commenter requested that the rule include relief for continued aircraft operation if a flight recorder or CVR becomes inoperative. The commenter was concerned that a time lapse may occur

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between the revisions to the Master Minimum Equipment List (MMEL) and the compliance date, also that MMEL lists may vary depending on who has responsibility for the particular aircraft MMEL. This rulemaking does not deal with minimum equipment lists and the problem suggested by the commenter, if necessary, would be handled under normal MMEL procedures.

A comment from a manufacturer stated that the NPRM implied "different sets of data between engine manufacturers." The commenter suggested additional engine information to be recorded for each engine:

N2 —High Rotor Speed
EGT—Exhaust Gas Temperature
TLA—Throttle Lever Position
N1 —Low Rotor Speed
WF —Fuel Low
CLA—Fuel Cutoff Lever Position

The commenter also suggested recording maintenance and status words from the electronic engine controls.

The FAA encourages including these additional parameters, as appropriate, but is not mandating them.

Construcciones Aeronauticas, S.A. (CASA) objected to the reference in the NPRM to two CASA C-212 accidents that occurred in 1987. CASA stated that some facts about the accident were incorrect in the NPRM and that the FAA should publish a correction. The FAA has checked the NTSB June 1988 recommendation letter and has determined that the NPRM accurately reflected the facts as they were stated by the NTSB in that letter.

A manufacturer of recorder equipment requested that the FAA consider the manufacturer's new type of cockpit recorder. Information on the recorder was submitted with the comment. The comment does not require an FAA response.

The Air Line Pilots Association (ALPA) comment, which was generally supportive of the proposal, requested a change in §121.343(e) which requires that required flight recorders "must be operated continually from the instant the airplane begins to takeoff roll until it has completed the landing roll at an airport." ALPA stated that this provision "hampers the collection of valuable data which can be used in evaluating the DFDR data." ALPA requested that the language be changed to require recorder operation to begin at the time of engine start to the time of engine shutdown at the end of the flight in order to provide "steady state" information. Two other commenters also requested that recording cover the ground operation phase.

No revisions to §121.343(e) were requested by NTSB or included in the proposed rule. The present Part 121 requirement was simply carried over to Part 91 and Part 135 requirements. A revision of the requirement is beyond the scope of this rulemaking action and would necessitate additional rulemaking proposals. However, most operators presently activate flight recorders at engine start and other operators who wish to record "steady state" data are encouraged to consider the ALPA comment.

ALPA also strongly opposes the "use of CVR recordings for any purpose other than pure accident investigation activities" and the "premature release" of CVR information during accident investigations.

One commenter stated a belief that "in recent years, because of the rapid growth of the airlines industry, training and experience levels have dropped. . . ." The commenter stated that the FAA should require additional training and safety measures rather than additional equipment. The FAA does not believe the situation is an either/or; FAA has taken action on training and other safety measures, for example, its windshear training proposal (52 FR 20560, June 1, 1987). In any event, consideration of additional pilot training and safety measures outside the area of recording equipment is beyond the scope of this rulemaking action.

Summary of Rule Changes

Significant changes between the proposed rule and the final rule are summarized below. These changes were discussed in the appropriate sections of the Comment Discussion above:

(1) The compliance dates have been extended from 2 years to 3 years.

(2) Pre-wiring requirements in §91.35 and §135.52 have been deleted.

(3) The requirements for airplanes currently equipped with a digital data bus are clarified in §§ 121.343(e) and 125.225(c).

(4) Certain of the parameters in Appendix B of Part 121 have been made optional.

(5) Aircraft required to be upgraded under §135.152(b) must meet the 11-parameter or 17-parameter flight recorder requirements (currently required of certain airplanes used under Part 121) except those manufactured after October 11, 1991.

(6) Requirements pertaining to the use of boom microphones have been clarified.

(7) The resolution readout column in each of the appendices has been made applicable only to aircraft manufactured after October 11, 1991.

The changes above were coordinated with the NTSB staff who have indicated agreement that this final rule meets the intent of the NTSB recommendations in its letter of June 19, 1987.

In addition to the above changes, Parts 23 and 27 have been revised to include airworthiness requirements for flight and voice recorders. In the proposal such airworthiness requirements were only in Parts 25 and 29, and all operators subject to flight and voice recorder requirements were referred to those parts. In the interest of consistency, the final rule includes airworthiness requirements for flight and voice recorders in Parts 23, 25, 27, and 29. References in the operating rule have been revised accordingly.

REQUEST FOR ADDITIONAL COMMENTS ON PART 91 REQUIREMENTS

Notwithstanding that the Part 91 requirements have been incorporated in this final rule, the FAA is still interested in receiving comments with respect to issues raised in Notice 88-1. The FAA is particularly interested in comments regarding the questions asked on page 4321 of the *Federal Register* publication of the notice (53 FR 4314). Therefore, a comment period of 90 days is being provided to allow the public to comment accordingly. The FAA will review all additional comments submitted and, within 1 year after the publication of this amendment in the *Federal Register*, will publish a document discussing all comments, presenting FAA findings based upon the comments, and proposing any revisions to the requirements contained herein, if necessary.

REGULATORY EVALUATION SUMMARY

The complete regulatory evaluation of the final rule is available in the regulatory docket. A discussion of those comments addressing the regulatory evaluation of the notice and a summary of the final regulatory evaluation are presented below.

Comments addressing the regulatory evaluation generally expressed concern about the costs of the proposed regulations, but provided very little detail in support of their conclusions. This was true with respect to both direct acquisition and installation costs, and indirect costs from factors such as reduced payload or aircraft range.

Some commenters stated that the amendments would impose a severe economic burden on small companies operating small aircraft for hire. The FAA is aware that the amendments will result in economic impacts. However, the Department of Transportation has been directed by the Congress to take these actions.

Some commenters misinterpreted the significance of the 10-year analysis period to mean that the FAA expected operators to spread their retrofit costs over 10 years. FAA's cost estimates were for total program costs over 10 years. In developing these estimates, retrofit costs were concentrated in the first two years of the analysis period. However, the FAA has extended the compliance period from the proposed 2-year period to three years in the final rule, which should provide relief to many operators.

Some commenters expressed concern about the high cost of retrofitting their aircraft. However, it appears they misunderstood that certain proposed flight recorder requirements would apply to newly manufactured aircraft only. Further, concerns were expressed that a 32 parameter retrofit requirement for 20 to 30 passenger seat aircraft operated under Part 135 would impose requirements that are more stringent than those requirements applicable to existing Part 121 aircraft. This issue has been resolved in the final rule by adopting requirements for existing 20 to 30 passenger Part 135 aircraft that are similar to the current Part 121 requirements.

One commenter stated that the FAA did not consider initial development and certification costs in its regulatory evaluation. However, the FAA did attempt to account for this by adding 10 percent to its equipment and installation cost estimates to provide for certification, start-up, and support equipment costs for proposals affecting aircraft operated under Parts 91, 125, and 135. This was not done for Part 121 because aircraft exist that meet the proposed requirements, and support equipment already is in service because of existing recorder requirements.

The regulatory evaluation of the final rule is very similar to the regulatory evaluation of the notice. Appropriate revisions have been made to reflect the extension of the compliance period from 2 years to 3 years, the easing of the flight recorder retrofit requirements originally proposed for larger Part 135 aircraft, and other minor clarifying changes.

Briefly, the costs of these rules result from the need to acquire, install, and maintain recorder equipment, as well as the cost of additional fuel consumption attributable to the additional weight of this equipment, and miscellaneous costs related to engineering and certification requirements, support equipment, and administrative start-up costs. The FAA estimates that the cost for all categories of aircraft affected by these rules will be approximately $297 ± million (1987 dollars), or a present value of $207 ± million when discounted back to the start of the ten-year analysis period using the 10 percent discount rate prescribed by the Office of Management and Budget. Other potential costs of this rule that have not been quantified include diminished payload carrying capability and/or reduced range that may affect some smaller aircraft as a result of the weight and volume of these recorders, as well as possible safety tradeoffs with other equipment, such as traffic alert and collision avoidance systems, ground proximity warning systems, weather radar, etc. Solid state technology potentially could avoid or reduce many of these costs and tradeoffs.

Flight recorders and cockpit voice recorders provide information only, which does not directly save lives or prevent accidents. Accidents and casualties are prevented by other actions, such as improvements in aircraft design or operating procedures, which may result from information gained by recorders. Because the benefits of recorders are indirect, they have only been discussed qualitatively in this analysis.

Flight recorders have proven effective in determinations of aircraft structural, mechanical, and systems failures that have led to corrective actions such as aircraft modifications or changes in operating procedures. Flight recorders are extremely useful in identifying the responses of flight crews to hazardous situations, and they contribute substantially to human factors analysis. Flight recorders also help define more precisely those operational problems that need to be addressed through research and development programs, such as windshear encounters. Further, many lessons learned from flight recorders, especially those concerning human factors and operational problems, are not limited to the particular aircraft type involved in an accident. Rather, they provide safety insights that are beneficial to all pilots operating many different types of aircraft under various operating rules. Additionally, recorders will aid significantly in the analysis of those accidents that will inevitably be experienced by aircraft utilizing new technologies, such as fly-by-wire control systems, canards, and extensive use of composite materials in aircraft structures.

INTERNATIONAL TRADE IMPACT ASSESSMENT

These amendments will have little or no impact on trade for either U.S. firms doing business in foreign countries or foreign firms doing business in the United States. The amendments will affect only U.S. air carriers and operators. Foreign air carriers are prohibited from operating between points within the United States; therefore, they would not gain any competitive advantage over the domestic operations of U.S. carriers. In international operations, foreign air carriers are not expected to realize any cost advantages over U.S. air carriers because many foreign countries have recorder requirements that are as stringent as those adopted in this final rule. Further, general aviation operations conducted in the United States are not in any direct competition with foreign enterprises. For these reasons, the FAA does not expect that these amendments will result in any trade impact.

REGULATORY FLEXIBILITY DETERMINATION

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that small entities are not unnecessarily and disproportionately burdened by government regulations. The RFA requires agencies to review rules that may have "a significant economic impact on a substantial number of small entities."

Any small entity that operates any aircraft in the categories that are included in the amendments to Parts 91, 121, 125, and 135 would be affected by this rule. Some of these amendments could result in "a significant economic impact on a substantial number" of small entity operators and air carriers. Most manufacturers that certificate aircraft under Parts 25 and 29 are not small entities and therefore are not subject to the RFA.

The following analysis explains the reasons for this determination concerning operators and air carriers. In developing estimates of annualized net compliance costs, uniform annualized costs for capital investments have been determined by multiplying the amount of the investment by a capital recovery factor appropriate for the discount rate and period of the analysis. A capital recovery factor of .155, based upon a 10 percent discount rate over a 10-year period, has been used in this analysis. Threshold cost values and small entity size standards are those stated in FAA Order 2100.14A, *Regulatory Flexibility Criteria and Guidance*. Values have been adjusted to 1987 dollars.

The threshold values defining a significant economic impact for scheduled carriers are $96,200 if the entire fleet has a seating capacity of over 60 seats, and $53,800 for other scheduled carriers. The threshold value for an unscheduled operator is only $3,800. Further, a small entity operator of aircraft for hire is defined as one which owns 9 or fewer aircraft.

The annualized cost for the least expensive requirement adopted in this final rule, a CVR retrofit, is approximately, $3,500 per aircraft. Therefore, an operator owning only one aircraft is very close to the $3,800 threshold for unscheduled operators, and any operator owning more than one aircraft is well over the threshold. This would apply to virtually all small Part 135 operators affected by the rule. A similar argument can be made for Part 125 operators owning only one aircraft because they would be required to retrofit the far more expensive flight recorders as well as CVR's. It is possible that a substantial number of small entities (defined as one-third of the small entities affected by the particular proposal) could incur significant economic impacts, particularly scheduled Part 135 operators (commuters) if they obtain between 6 and 9 new aircraft with 19 or fewer seats, or retrofit between about 4 and 9 aircraft with 20 to 30 seats. Further, any small unscheduled Part 121 operator purchasing one or more new aircraft not equipped with a digital data bus and digital flight data acquisition unit (DFDAU) will exceed the threshold for nonscheduled operators.

Part 91 operators of aircraft affected by these proposals generally are not small entities, however, and therefore would not be subject to the RFA. For these reasons, the FAA has determined that these amendments may have a significant economic impact on a substantial number of those small entities operating under Parts 121, 125, and 135, and a regulatory flexibility analysis is required under the terms of the RFA. The final regulatory flexibility analysis follows below.

FINAL REGULATORY FLEXIBILITY ANALYSIS

As required by Section 604 of the RFA, the following analysis deals with the proposed flight recorder requirements as they relate to small operators.

A. *Why Agency Action is Taken*

This rulemaking is in response to Congressional action and to several recommendations made by the NTSB. The reasons for agency action are detailed in the preamble and the regulatory evaluation.

Briefly, the advantages of additional recorded information have been demonstrated by those aircraft so equipped, and it is desirable that more specific information be obtained following an accident involving additional categories of aircraft than is possible under current regulations.

B. *Summary of Issues Raised by Public Comments*

Comments addressing those issues identified in the initial regulatory flexibility analysis as potentially affecting small entities primarily concerned the impact of the proposals on Part 135 operators. These commenters generally expressed concern that the proposals would impose unreasonable costs on operators in comparison to any safety benefits that might result. (Similar comments were received concerning Part 91 operations. However, those entities that conduct Part 91 operations in aircraft that will be affected by this rule generally are not small entities.)

In view of the data submitted, the final rule has been modified to extend the compliance period from 2 years to 3 years; and the flight recorder retrofit requirements for 20 to 30 passenger seat Part 135 aircraft have been reduced from the 32 parameters proposed, to only 11 or 17 parameters, depending upon the date of type certification (essentially, the same requirements as those currently in Part 121).

C. *Alternatives to the Proposal*

Other than those revisions discussed above, no alternatives to these proposals have been considered. The Secretary of Transportation has been directed by Congress to initiate a rulemaking that considers the recommendations of the National Transportation Safety Board to the Federal Aviation Administration concerning the use of cockpit voice recorders and flight data recorders on commuter and other aircraft. The FAA has concluded that Congress intended the NTSB to have available whatever data it needs for accident investigation purposes if acquiring that data is technologically feasible.

FEDERALISM IMPLICATIONS

The regulations set forth in this notice are proposed under the authority in the Federal Aviation Act of 1958, as amended (49 U.S.C. 1301 et seq.). The FA Act has been interpreted to preempt State law regulating the same subject. Thus, in accordance with Executive Order 12612, it is determined that this proposed regulation does not have federalism implications requiring the preparation of a Federalism Assessment.

CONCLUSION

The FAA has determined that this amendment is not major under Executive Order 12291 but that it is significant under the Department of Transportation Regulatory Policies and Procedures (44 FR 11034, February 26, 1979). For the reasons discussed above, it also has been determined that the rule may have a significant economic impact on a substantial number of small entities.

The Rule

Accordingly, the Federal Aviation Administration amends Parts 23, 25, 27, 29, 91, 121, 125, and 135 of the Federal Aviation Regulations, effective October 11, 1988.

The authority citation for Part 25 is revised to read as follows:

Authority: **49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).**

Amendment 25-66

Improved Flammability Standards for Materials Used in the Interiors of Transport Category Airplane Cabins

Adopted: August 19, 1988 **Effective: September 26, 1988**

(Published in 53 FR 32564, August 25, 1988)

SUMMARY: These amendments upgrade the fire safety standards for cabin interior materials in transport category airplanes by establishing refined fire test procedures and apparatus and a new requirement for smoke emission testing. The refined test procedures and apparatus are the result of additional research and fire testing and are intended to improve the reproducibility of test results. The refinement for smoke emission testing is intended to minimize the possibility that emergency egress will be hampered by smoke obscuration. In addition, the operating rules for air carrier (Part 121) and air taxi (Part 135) operators, which were adopted in the original final rule, are amended to enable additional compliance time to be granted for the few interior components for which timely compliance cannot be achieved.

The FAA findings concerning the requested additional comments on the final flammability criteria are also presented.

FOR FURTHER INFORMATION CONTACT: Gary Killion, Manager, Regulations Branch (ANM-114), Transport Airplane Directorate, Aircraft Certification Service, Federal Aviation Administration, 17900 Pacific Highway South, C-68966, Seattle, Washington 98168; telephone (206) 431-2114.

SUPPLEMENTARY INFORMATION:

Background

Notice of Proposed Rulemaking (NPRM) No. 85-10, which was published in the *Federal Register* on April 16, 1985 (50 FR 15038), proposed to upgrade the flammability safety standards for materials used in the interiors of transport category airplane cabins.

As discussed in the notice, the FAA established a committee in June of 1978 to examine the factors affecting the ability of the aircraft cabin occupant to survive in the post-crash environment and the range of solutions available. The Committee was composed of fire safety experts from the FAA, National Aeronautics and Space Administration, the aerospace industry, and the general public. Included in the recommendations of this committee, which was known as the Special Aviation Fire and Explosion Reduction (SAFER) Advisory Committee, were further research and development in regard to cabin materials and prompt evaluation and implementation of a method using radiant heat for testing cabin materials. The FAA concurred and initiated the necessary research and development. The resulting research and development program, which was managed and conducted primarily at the FAA Technical Center in Atlantic City, New Jersey, was designed to study aircraft fire characteristics, develop practical test methods, and investigate the feasibility of the various new standards being considered at that time.

Among the tests conducted at the Technical Center were full-scale fire tests using the fuselage of a military C-133 configured to represent a widebody jet transport. The test conditions simulated representative post-crash external fuel-fed fires. Numerous laboratory tests were also conducted to correlate possible material qualification test methods with the full-scale tests. As a result of these tests, the Ohio State University (OSU) rate-of-heat-release apparatus, as standardized by the American Society of Testing and Materials (ASTM), ASTM-E-906, was determined to be the most suitable for material qualifications. The OSU rate-of-heat-release apparatus utilizes radiant heat, which the SAFER Advisory Committee recommended because it is most representative of the post-crash fire environment. The ability of the test method to adequately discriminate acceptable from unacceptable materials was verified using several generic materials. The generic materials covered a range of flammability characteristics and each was tested and ranked in the full-scale fire test facility. Sample materials were then tested and ranked using the OSU apparatus. The ranking of materials from the OSU tests was identical to that obtained in the full scale fire facility. Thus, the OSU apparatus demonstrated that it would properly rank the relative performance of interior materials in typical post-crash fires. The acceptance criteria proposed in Notice 85-10 were chosen in order to produce a significant retardation of the flashover event which controls occupant survivability, as experienced in the full-scale testing.

As proposed in Notice 85-10, all large interior surface materials installed above the floor in compartments occupied by the crew or passengers would have to comply with the new flammability standards. This would include sidewalls, ceilings, bins and partitions, galley structures, and any coverings on these surfaces. Smaller items, such as windows, window shades, or curtains, would not be included. Floor coverings, floor structure, seats, and service items would not be included for the reasons discussed in Notice 85-10.

As proposed, Part 25 would have required the use of cabin interior materials meeting the new flammability standards for all transport category airplanes for which application for type certification is made after the effective date of the amendment. As originally proposed, Part 121 would have required the use of such materials in all large airplanes newly manufactured 2 years or more after the effective date of the amendment and operated under the provisions of Part 121 or 135, regardless of the basis for type certification. (Section 135.169(a) incorporates the provisions of § 121.312 by reference insofar as operations with large airplanes are concerned.) In addition, all other large airplanes type certificated after January 1, 1958, and operated under the provisions of Part 121 or 135 would have had to be modified to use such materials the first time the cabin interior is replaced after a date 2 years from the effective date of the amendment.

The public comment period for Notice 85-10 originally closed on July 15, 1985; however, as announced in Notice 85-1OA (50 FR 30447; July 26, 1985), it was reopened until September 9, 1985. Subsequent to the development of Notice 85-10, an industry trade association and the FAA Technical Center completed two series of round-robin tests to assess the reproducibility of test results using the OSU rate-of-heat-release apparatus among various laboratories. In the round-robin testing, the same group of materials was tested by each laboratory. This assessment was necessary because preliminary testing by the industry to evaluate the impact of the proposed rule yielded results significantly different from those obtained using the FAA OSU apparatus. During the retesting, samples of actual in-service panels and several materials representative of in-service interior panels were tested by the FAA, OSU, and two large airplane manufacturers. The first series of tests completed subsequent to issuance of Notice 85-10 indicated that the FAA apparatus had an incorrect heat flux calibration, and there were several significant areas where the other test apparatus differed from that of the FAA. The non-FAA test apparatus were modified to more closely match those of the FAA. After the second series of round-robin tests, much closer results were achieved among the laboratories.

Based on the round-robin tests, the Technical Center recommended certain adjustments in test procedures and acceptance criteria. In particular, the recommendations included: (1) adjustment of the specimen exposure heat flux from 5 watts per square centimeter (W/cm^2) to 3.5 W/cm^2; (2) elimination of the oxygen depletion method of measuring heat release, leaving only the thermopile method; (3) adjustment of the acceptance criteria for total heat release over the first 2 minutes of sample exposure from 40 to 65 kilowatt-minutes per square meter; and (4) inclusion of a requirement for a peak heat release rate of 65 kilowatts per square meter. The FAA outlined these recommended adjustments in Notice 85-1OA and requested public comments thereon.

Following the close of the reopened comment period, all comments were carefully considered; and Amendments 25-61 and 121-189 (51 FR 26208; July 21, 1986) were adopted accordingly. For reasons discussed in the preamble to these amendments, the adopted standards differ from those originally proposed in a number of respects:

1. The adjustments in test procedures and acceptance criteria recommended by the FAA Technical Center and proposed in Notice 85-10A were adopted in lieu of those originally proposed in Notice 85-10.

2. Airplanes with maximum seating capacities of 19 passengers or less are not required to meet the new standards.

3. As proposed, airplanes newly manufactured 2 years or more after the effective date and certain other airplanes in which the cabin interior is replaced 2 years or more after the effective date would have had to meet the new standards. As adopted, airplanes newly manufactured on or after August 20, 1988, must meet interim standards, and those newly manufactured on or after August 20, 1990, must meet the definitive standards. Similarly, certain airplanes in which the cabin interior is replaced on or after August 20, 1988, or August 20, 1990, must meet the interim or definitive standards, respectively.

4. Other nonsubstantive editorial changes were made for clarity.

Commenters responding to Notice 85-10 contended that the progress of this rulemaking initiative was, in general, outpacing developments in materials technology. Nevertheless, the FAA did not consider the comments received by that time sufficient to warrant abandoning the rulemaking or delaying it further, considering the increases in fire-safety that would be achieved. Amendments 25-61 and 121-189 were adopted accordingly; however, the FAA did request further comments on both the test procedure and the appropriateness of the performance criteria. The closing date for the further comments was January 21, 1987. The FAA stated that a document discussing all comments received, presenting FAA responses, and proposing any necessary further revisions to the new standards of Amendments 25-61 and 121-189, would be published in the *Federal Register*.

Following completion of the final rule but prior to its publication in the *Federal Register*, the Aerospace Industries Association of America (AIA) and Air Transport Association of America (ATA) jointly petitioned for further rulemaking that would substitute different test procedures and acceptance criteria. This petition was published in the *Federal Register* on July 21, 1986 (51 FR 26166) along with a request for public comments thereon.

As also discussed in the preamble to Amendments 25-61 and 121-189, some commenters expressed concerns regarding repeatability of test results using the FAA OSU test apparatus and procedures. The commenters noted that, in addition to the initial type certification testing, succeeding material lots would have to be tested from a production standpoint to ensure that their heat release characteristics are not degraded from those of the material lot originally tested for type certification. Variations in test results would, therefore, necessitate the use of materials that nominally exceed the new standards of Amendments 25-61 and 121-189 to ensure that the results of individual tests are satisfactory. Such variations in test results could also create a situation in which a given material is found acceptable in the testing conducted by one manufacturer while the material is found unacceptable by another manufacturer. As a result of these concerns, the FAA conducted a third series of round-robin tests to determine whether certain additional refinements in the apparatus and procedures would improve the repeatability of test results. These tests were conducted at the FAA Technical Center, the facilities of two airplane manufacturers, and OSU, using common test specimens. Based on the results of these tests, the FAA Technical Center recommended certain further adjustments in the test apparatus and procedures.

Subsequent to the original closing date for comments but prior to their consideration, the Aviation Staff of the U.S. House of Representatives Committee on Public Works and Transportation requested the FAA to participate in a meeting held on February 6, 1987, concerning the interior materials rulemaking. The purpose of this meeting, which was also attended by representatives of the AIA, ATA, General Aviation Manufacturers Association (GAMA), Association of Flight Attendants (AFA), National Bureau of Standards (NBS) and Office of Management and Budget (OMB), was to enable the committee staff to hear an exchange of views concerning this rulemaking between the FAA and industry representatives. Minutes of this meeting, as prepared separately by the FAA, the AIA, and the ATA, have been added to the docket.

In response to requests from the AIA, ATA, and Suppliers of Advanced Composite Materials Association (SACMA), the comment period was reopened to April 21, 1987 (52 FR 5422; February 20, 1987). In conjunction with reopening the comment period, the FAA also outlined the further adjustments in the test apparatus and procedures recommended by the FAA Technical Center and requested public comments thereon.

Discussion of Comments

Comments were received from a diversity of interested parties ranging from organizations representing various domestic and foreign aircraft manufacturers and operators, to aviation trade unions. Commenters also included government organizations, foreign airworthiness authorities, and producers of candidate interior materials. Due to their interrelationship, comments received in response to the AIA/ATA joint petition for rulemaking have been considered along with those received in response to the request for comments contained in the preamble to Amendments 25-61 and 121-189. Virtually all commenters supported the intent of these amendments to increase airplane fire safety. Many of the commenters are in full support of the standards established by these amendments, while others express concerns regarding the viability of the test method, availability of suitable materials, and cost of compliance.

Three commenters are critical of the full-scale testing that was the basis for the new standards. In that regard, one noted that the testing did not include consideration of external wind effects. While the full-scale testing was conducted in zero wind conditions, the effects of wind were considered. The full-scale testing was preceded by a series of tests in which the effects of wind were evaluated. From those tests, it was concluded that a zero wind condition is the most critical insofar as the contribution of interior materials to the fire is concerned.

Two commenters note that the panels used in the full-scale testing were "generic" and differed somewhat from actual panels used in specific airplane models. Due to these differences, the commenters allege that the results of the full-scale testing are invalid. One of the two commenters recommends that the full-scale fire test should be repeated with industry support using interior panels "acceptable for aircraft interiors." Prior to conducting the full-scale testing, the FAA attempted to purchase representative panels used in actual airplanes. Because the aircraft manufacturers were unable or unwilling to supply such panels, it was necessary to obtain "generic" panels constructed specifically for the testing. While these panels did differ in detail from panels used in actual airplanes, they were constructed of five basic types of facing materials used in the construction of panels of actual airplanes, and the decorative film and the honeycomb core used in the construction of such panels. Following completion of the full-scale testing, specimens of these "generic" panels were used in laboratory tests to obtain a correlation of laboratory test data with the data from the full-scale testing. Because the "generic" panels were used primarily to correlate full-scale and laboratory test data, their use did not, in any way, invalidate the results of the full-scale test. Rerunning the full-scale test would, therefore, provide no benefit insofar as this rulemaking is concerned; and it would unduly delay the safety benefits that will result from the new standards.

One commenter points to a full-scale test conducted in the Federal Republic of Germany as evidence that the FAA correlation of full-scale and laboratory testing has not been proven. The commenter asserts that the latest state-of-the-art materials were used in this test which was conducted in June of 1986 by the Ministry of Transport. The final report of this test is not available to the FAA as of this writing; however, the FAA has been advised informally that the test was conducted using a portion of the fuselage of a wide body transport category airplane currently produced in Europe with interior furnishings that are typically used in that airplane model. Contrary to the commenter's assertion, the FAA has been advised that the interior materials involved had very high heat release values. The fact that an early flashover occurred when materials with high heat release values were used supports the FAA correlation of full-scale and laboratory testing rather than discredits it.

A number of commenters express their belief that the OSU rate-of-heat-release apparatus and procedures are not viable means to establish the acceptability of materials used in the interiors of airplanes. In this regard, they note variations in test results that were obtained when specimens of the same materials were tested in different facilities. As noted above, a round-robin test series was conducted shortly after the issuance of Notice 85-10. During that test series, it was found that the heat release readings obtained at the FAA Technical Center were consistently lower than those obtained with the same materials at each of the other three facilities. Since that time, refinements in the test apparatus and procedures have been developed and verified in two subsequent round-robin test series. These refinements, which are adopted herein, have reduced the variations in test results considerably, and the FAA Technical Center facility no longer consistently produces the lowest test results. The reproducibility has been reduced to ±7.68 percent standard deviation for total heat release and to ±7.82 percent for peak heat release. The repeatability of test results at a given facility has also been improved. The average of the repeatability at the five facilities is ±5.23 percent. It must be noted that the test procedures specify that the total heat release readings for each of three or more samples must be averaged and the peak heat release for each of the samples must also be averaged. Averaging the readings of three or more samples mitigates the remaining differences due to test repeatability considerably. One commenter asserts that it is absolutely essential that all test chambers give the same results at all times. This, of course, is a desirable goal, but its achievement is impossible, as it is with any testing. Considering the inherent variability in fire testing, these reproducibility and repeatability values are considered to be remarkable. They are, in fact, much better than those that would be obtained with Bunsen burners which have been FAA standards for fire testing for years.

One commenter states that the FAA did not determine whether other laboratory test devices could be developed to reliably predict the full-scale fire performance of cabin interior materials, and another recommends that the FAA should do so at this time. Contrary to the commenter's statement, the FAA has considered other devices. The FAA sponsored a study by the NBS in which the relative performance of the OSU apparatus, the NBS cone calorimeter, and other possible devices were compared. While the NBS reported ("The Role of Aircraft Panel Materials in Cabin Fires and Their Properties"; DOT/FAA/CT-84/30 dated June 1985) only fair agreement for energy release data, the materials tested were ranked in the same order by the two devices. An independent comparison of the OSU apparatus, the NBS cone calorimeter, and a Swedish device was conducted in Sweden and reported in the *Journal of Fire and Materials* Vol. 9, No. 4, 1985. According to the report, there was a good correlation of test results among the three devices. There is, therefore, no basis on which to believe that the NBS cone calorimeter or any other device is superior to the OSU rate-of-heat-release apparatus. Unlike that with the OSU apparatus, there has been very little experience in testing airplane interior materials with the other devices; and considerable development would be required to reach the current performance level of the OSU apparatus. The substitution of another device, such as the NBS cone calorimeter, as the required test method would result in an unwarranted delay in the introduction of improved materials in service. In addition, the NBS cone calorimeter is understood to be considerably more expensive than the OSU apparatus, and none are currently in service or available to U.S. airplane manufacturers. Nevertheless, an applicant would have the option of developing and utilizing an alternate test method, such as the cone calorimeter, under the equivalent level of safety provisions of § 21.21(b)(1).

Some commenters assert that the OSU rate-of-heat-release apparatus and the definitive acceptance criteria of 65 kilowatt-minutes per square meter and 65 kilowatts per square meter do not separate materials they characterize as "desirable" from those that are "undesirable." In this regard, they cite test results in which certain specimens of "undesirable" materials are shown to have heat release characteristics that are better than those of certain specimens of "desirable" materials. Contrary to this assertion, the OSU apparatus and the acceptance criteria do discriminate all but borderline materials. Actually, there is no definition of "desirable" and "undesirable" in this context. These criteria are standards; and, as such, are the minimum values considered acceptable in light of the full-scale testing. It must be recognized that there are frequently variations in examples of a basic generic material and corresponding ranges in performance. These may be due to production tolerances or may be the result of intentional tailoring of the material composition and processing for specific applications. There may also be variations in the finished products due to the type and thickness of decorative finishes applied. Due to these variations, materials cannot be considered desirable" or "undesirable" on a generic basis. Individual component specimens could exceed the 65 kilowatt-minutes per square meter and 65 kilowatts per square meter standards as long as the average of the heat release values for the tested specimens of that component is equal to or below the 65/65 standard. The FAA has worked with the manufacturing industry to develop improved quality control measures to minimize variations between specimens of components tested in the OSU test chamber. In the case of borderline materials, it must be recognized that some samples will pass and some will fail due to these variations.

Several commenters question the statement in the preamble to Amendments 25-61 and 121-189 that, "compliance with this rule is possible within the current state-of-the-art in cabin materials." In this regard, they assert that the new definitive standards of 65 kilowatt-minutes per square meter and 65 kilowatts per square meter are beyond the capability of the best state-of-the-art materials used in current production and that new materials and processing technology must be developed before industry can comply with the rule. One commenter further states that virtually every interior part in current production must be changed. The reference to "current state-of-the-art" was not intended to mean that the components currently produced for the interiors of transport category airplanes would all meet the new standards. If that were the case, the new standards would provide no improvement in safety. Instead, the statement referred to materials which are currently in production by material suppliers and from which such components can be fabricated by the airplane manufacturers. Clarification of this point has been made to the industry on numerous occasions. The commenter further states that new technology, at present unidentified and undefined, is required for some areas of the interior in order to comply with the new standards. Another commenter states that none of the new candidate materials are viable because they have characteristics that are unacceptable for production airplanes. The commenter then lists six such materials or processes and provides reasons why, in the commenter's opinion, none of the six can be used to meet the new standards. Typically, the reasons cited include high forming temperatures and the need for new, sophisticated tooling.

In contrast to these negative comments, other commenters cite various new materials and processes which meet the definitive standards and are available. Although new or modified manufacturing processes are required in some instances, the materials are currently being produced and are available for use in the manufacture of the interior components. That components made from these materials will meet the definitive standards is evidenced by testing conducted at the FAA Technical Center and other test facilities. It must be noted that, in most instances, these new materials are the products of established, credible companies. It appears that some of the negative comments were based on earlier variants of these materials, as the disadvantages cited for some of the materials are not currently true.

Some of the major interior components currently in service also meet the new standards. One major manufacturer, for example, has been producing transport category airplanes for a number of years with interior sidewall panels constructed of aluminum with a laminated decorative finish. This construction easily meets the new flammability standards. It is alleged by one commenter that such panels are less resistant to penetration of an external fire into the cabin and therefore present a greater hazard than certain other materials that do not meet the new standards. It appears, from testing previously conducted by the FAA, that flame penetration through windows or possibly through the cabin air return grills would occur much earlier than penetration through the fuselage external surface, any insulating material, and the aluminum interior panels. In any event, flashover from such a fire would occur much later than it would occur from a fire that enters the cabin through a fuselage rupture, giving occupants more time to egress safely.

The phenolic resin fiberglass construction extensively used by another major airplane manufacturer marginally meets the new standards. This construction appears to be too marginal as currently used to be a viable means of compliance, considering production tolerances, test variations, etc. Nevertheless, it easily meets the new standards with the application of a recently developed, currently produced laminate.

In light of this and other information available to the FAA, the contention that no materials will be available in time to meet the definitive standards is not credible. Nevertheless, it is recognized that no single material or construction is feasible for use in every component that must meet the new standards, due to various functional and aesthetic considerations. While the FAA does not agree that the concerns stated by the commenters are, or are likely to become, widespread, additional time may be needed in order to develop new materials and production methods for a few unique components. For example, carpeting is generally used on the lower cabin sidewall panels, for protection from abrasion. To date, no carpeting, or other material suitable for such protection, has been shown to meet the new standards. (Carpeting used as a floor covering does not have to meet the new standard for the reason discussed in Notice 85-10.) Additional time will be needed to develop carpeting that meets the new standards or a suitable substitute material. Many materials that meet the new standards and can be used in the fabrication of typical interior components cannot be used in the fabrication of certain other components due to unique shape or functional considerations. There are promising new materials that can be used for these unique components; however, additional time will be needed to develop new fabrication processes for those materials. Rather than addressing these concerns by issuing an extension of the compliance time for materials in general, the FAA is providing for an evaluation, on an individual basis, of those relatively few components which may not meet the new standards. If, as a result of that evaluation, a determination is made that special circumstances exist that make compliance impractical, and that there would be no significant adverse effect on the overall flammability of the cabin, relief may be granted with respect to those few components. Section 121.312(a) is amended to enable the Manager of the Aircraft Certification Division, FAA Northwest Mountain Region, to grant such relief in the form of a deviation from the requirements of that paragraph. A request for a deviation from the requirements of § 121.312(a) must be based on a thorough and accurate analysis of each component used in the airplane cabin, the steps that are being taken to achieve substantial compliance, and, for the few components for which timely compliance cannot be achieved, credible reasons for such noncompliance. Such deviation may be granted to operate airplanes manufactured within 1 year after the applicable date specified in § 121.312(a) or those in which the interior is replaced within 1 year after that date.

Following completion of Amendments 25-61 and 121-189, but prior to their publication in the *Federal Register*, the ATA and AIA jointly petitioned for further rulemaking in which the standards contained in Amendments 25-61 and 121-189 would be replaced by alternate test criteria and standards which they proposed. The ATA and AIA, which represent the major U.S. airlines and the major U.S. manufacturers of transport category airplanes, respectively, were supported in their petition by certain European airplane manufacturers and the International Air Transport Association (IATA). As noted above, comments received in response to this petition were considered along with those received in response to the request contained in the preamble to Amendments 25-61 and 121-189. In essence, the petitioners' proposal involves the following:

1. The adopted definitive standards of 65 kilowatts per square meter for peak heat release and 65 kilowatt-minutes per square meter for 2 minutes would be relaxed to 100 Kilowatts per square

meter and 100 kilowatt-minutes per square meter, respectively. These proposed final standards would be the same as the interim standards currently required by Amendment 121-189. The OSU test apparatus and procedures would be retained.

2. The time by which affected components would have to meet the proposed standards would be delayed from August 20, 1988, until a date 3 years after the new rulemaking became effective.

3. A smoke release test using the NBS Smoke Chamber (ASTM F814-83) would be required. Although not currently required by regulation, the petitioner states that the NBS smoke chamber is already in use by domestic and European airplane manufacturers as part of their materials acceptance procedures.

4. A two-tier certification procedure would be used. In lieu of testing representative completed parts, only the basic material systems from which parts would be fabricated later would be subjected to the OSU radiant heat release test and the smoke test. Completed parts would be subjected only to the flammability test requirement that was in effect prior to the adoption of Amendments 25-61 and 121-189.

In support of their proposal, the petitioners assert that adoption of these changes would enhance public safety by the use of proven fire test methods to eliminate the use of undesirable cabin materials and would permit the orderly incorporation of improved materials in production airplanes with a minimum of disruption to public service. The petitioners' proposal is based on the premise that the standards of Amendments 25-61 and 121-189 preclude the use of certain "desirable" materials because their peak and 2-minute heat release values exceed 65 kilowatts per square meter and 65 kilowatt-minutes per square meter, respectively. Raising these standards to 100 Kilowatts per square meter and 100 kilowatt-minutes per square meter would allow these materials to pass insofar as testing with the OSU apparatus is concerned. In order to preclude the use of "undesirable" materials that have heat release values less than 100 kilowatts per square meter and 100 kilowatt-minutes per square meter, a smoke test would also be required. According to the petitioners, "undesirable" materials in this heat release range have excessive smoke release characteristics.

A number of commenters support the petitioners' proposal by citing their beliefs that the OSU apparatus and test procedures do not discriminate "desirable" materials from those that are "undesirable" and that there will be no materials or processes available in sufficient time to comply with the new standards.

Other commenters disagree. Some cite various available materials and processes which are already or will be available to meet the new standards. Some question the validity of the smoke test in assessing the flammability characteristics of interior materials.

The petitioners propose a delay in implementing the new standards until a date 3 years after the date on which their proposed rulemaking would become effective. Considering the time required for the normal rulemaking process, this would mean that the petitioners' proposed standards would not be implemented for at least 4 years. None of the commenters, including the petitioners, have presented convincing arguments to date as to why even the much more stringent adopted definitive standards cannot be met by August 20, 1990. As most of the affected components in currently manufactured transport category airplanes already meet the petitioners' standards, there is virtually no evident need for the proposed delay if the petitioners' proposed standards were adopted.

As noted by the National Transportation Safety Board (NTSB) in their comments to the docket, there has been no scientific correlation made between the rate of heat release and smoke production. The NTSB comment is consistent with testimony of NBS and FAA Technical Center fire safety experts in the meeting with the Staff of the House of Representatives Committee on Public Works and Transportation on February 6, 1987.

As shown in the full-scale test and other testing, the critical factor in survivability is the time afforded for egress before flashover occurs. The release of large quantities of heated gases, which eventually result in flashover, is not relative to the amount of smoke released. The correlation of the amount of heat released by materials to the time of flashover and, in turn, to the time in which survival is possible is based on scientific testing and analyses conducted by the FAA and others. In contrast, the fact that certain materials, which are classed as "desirable" by the petitioners and the supportive commenters, exhibit low smoke release characteristics is a fortuitous coincidence, and any conclusions derived from that coincidence are not based on scientific evidence. In this regard, the FAA understands that the interior materials involved in the early flashover experienced in the German full-scale test met the manufacturer's smoke emission criteria.

The NTSB also concurs with the FAA belief that insufficient flammability data are available to determine whether there is a correlation between the flammability of individual components of an assembled system and the flammability of the system. The FAA is, in fact, unaware of any data developed to show such a correlation. The petitioners' proposal to use a two-tier certification procedure is, therefore, considered inadequate.

One commenter recommends that the Fire Research Center of the NBS should review the technical basis of the new flammability standards as adopted (i.e., the correlation of large-scale and laboratory testing, the test procedure and the acceptance criteria) and the petitioners' proposal. The NBS has already reviewed the new standards. There was, in fact, extensive cooperation between the FAA Technical Center and the NBS throughout the development of these standards. In regard to the petitioners' proposal, a fire safety expert of the NBS testified, in the meeting with the Staff of the House of Representatives Committee on Public Works and Transportation, that there was no scientific correlation of smoke release and flammability of materials.

Because there is no known correlation between smoke release and flammability, the petitioners' proposal would merely relax the standards adopted with Amendments 25-61 and 121-189. There are few interior materials used in current production of transport category airplanes that do not have heat release characteristics that are better than the standards proposed by the petitioner. There would, therefore, be virtually no improvement in cabin fire safety if the petitioners' proposal were adopted in lieu of the recently adopted standards of Amendments 25-61 and 121-189.

Some commenters do, however, believe that standards for smoke emission should be established in addition to the recently adopted flammability standards. Although smoke testing has not been shown to be of any value as a substitute for appropriate flammability standards, they believe that it should be conducted to minimize any direct hazards due to smoke, such as obscuration of escape routes, etc. Smoke testing was proposed by the ATA and AIA in their joint petition for rulemaking and offered for public comment. In light of the comments received and because it would place no additional burden on the manufacturers, § 25.853(a) and Appendix F are amended to require smoke testing in order to preclude the indiscriminate use of materials which produce excessive smoke, since suitable alternative materials are available. A corresponding amendment is also made to § 121.312(a) to require smoke testing coincident with the definitive rate of heat release standards.

The final disposition of the petitioners' request is the subject of a separate document and, except as noted above, no further action concerning their proposals is taken insofar as this rulemaking is concerned.

Two commenters believe that the flammability standards should be extended to window shades, and one of the two believes that they should also be applicable to curtains. Small parts, such as window shades, are not required to meet the new standards because their overall contribution to the flammability of the cabin interior is small. It is also noted that window shades are normally retracted behind the sidewall panels and not exposed to flames during the time period in which survival is still possible. The OSU rate-of-heat-release apparatus and procedures are not adaptable for testing fabrics. Requiring curtains to meet heat release standards would require the development of a new test method which would be beyond the scope of this rulemaking.

One commenter believes that tapestries installed on bulkheads for aesthetics should be excluded from meeting the new standards. The commenter asserts that they constitute less than 1 percent of the interior lining's exposed surface; they are local and isolated so that they cannot contribute to the progression of a flame in a longitudinal direction; and their contrast in design, color and texture adds an important element to the otherwise stark interior lining. The FAA does not concur that such tapestries should be excluded. The addition of the tapestry as an integral part of the bulkhead may compromise the ability of the bulkhead to meet the new standards and add to the overall flammability of the interior. The comment that such tapestries cannot contribute to the progression of a flame in a longitudinal direction does not appear to be relevant, as a bulkhead containing a tapestry may be near a rupture in the fuselage sidewall. If there were such a rupture, the bulkhead could be in the direct path of an external fire as it enters the cabin. Although such tapestries do improve the appearance of the interior, the safety improvements that will result from the new rule far outweigh any aesthetic considerations.

One commenter notes that § 25.853(a-1) states: "...The outer surfaces of galleys..." and inquires whether this means the outer decorative finish will be tested and structural panels will not be tested. Structural items, to the extent they form the outer surfaces of galleys, large cabinets, stowage bins, etc., must be tested with the decorative laminate installed. Internal structure that is protected from exposure to flames during the time period when survival is possible (i.e., until flashover occurs) is not required to meet the new standards.

One commenter believes that passenger stowage bins may be opened and left open by passengers in panic situations after a controlled crash. The commenter, therefore, believes that the construction materials used on the inside of stowage bins should also meet the new standards. While it is possible that some bins may be left open, they will generally remain closed on instruction of the crewmembers to leave personal belongings behind and evacuate the airplane immediately. For the few that might be left open, much of the interior surface would be isolated from the fire by the bin contents. It is, therefore, not considered necessary to require the inner surfaces of passenger stowage bins to meet the new standards. Generally, the inner surfaces of such bins are constructed of the same material as the outer surfaces, less the decorative laminate. In that case, the materials would be shown to meet the new standards when tested as an outer surface.

One commenter inquired as to whether the test is to be conducted with a simulated specimen made with the same materials and processes used for the production article or with the individual surface components. Another commenter recommends that the final specification of test panel thickness be delayed until more experience has been gained in interior panel construction with the new materials. Section 25.853(a-1) specifies the components which must meet the requirements of Part IV of Appendix F. It is not necessary to test the production articles, per se; however, the test specimen must have a thickness representative of the production article, rather than an arbitrarily specified thickness, in order to ensure that the production article does, indeed, meet these standards.

One commenter believes the figures are deficient and must be revised in order to better reflect the test apparatus. The commenter does not note any specific areas; however, the FAA will monitor compliance with the new standards and propose changes to the figures in the future if shown desirable as further experience is gained. In the same vein, another commenter believes an advisory circular (AC) should be prepared to provide guidance in showing compliance with the new standards. The FAA concurs that the preparation of an AC could be beneficial; however, the FAA does not consider it to be essential or necessary for compliance with the rule. It will, therefore, be delayed in order to benefit from the initial experience in showing compliance with the new standards.

Two commenters request further clarification of the phrase "substantially complete replacement" that appears in § 121.312(a)(5) and (6). For reasons discussed in the preambles to Notice 85-10 and to Amendments 25-61 and 121-189, these subparagraphs generally apply only when all of the components subject to § 25.853(a-1), i.e., interior ceiling and wall panels (other than lighting lenses), partitions, and the outer surfaces of galleys, large cabinets, and certain stowage compartments, are replaced. The qualifying term "substantially complete" is used, however, to ensure that persons cannot circumvent the intent of the rule by replacing all but a small, insignificant portion of the components. Generally, there would be a complete replacement of the interior if all but a few units of the affected components are replaced. For example, compliance with the new standards would be required if all of the components subject to § 25.853(a-1), except a few sidewall panels, were replaced, or if all but a few storage bins were replaced. It is not possible to precisely define "few units," because the number will vary with the total number of units in the airplane and the relative size of the units. It is recognized that a person could avoid using materials that meet the new standards by replacing a portion, e.g., 50 percent, at one time, and the remainder at a later date. It does not, however, appear that this will become a widespread practice. Nevertheless, if materials that do not meet the new standards do remain in service in a significant number of air carrier airplanes because they are not replaced as anticipated, and a substantial increase in overall safety can be realized, the FAA will, as noted in the preamble to Notice 85-10, consider a mandatory retrofit program in a subsequent rulemaking action.

Two commenters suggest editorial changes for clarity. One believes that a new § 25.853(a-2) should be added to state that, "smaller items, such as windows, window shades, or curtains, as well as floor coverings, floor structure, seats, and service items, are not included and do not have to meet the requirements in (a-1). All of such materials have to meet the flammability requirements prescribed in paragraph (a) of this part." As discussed in the preamble to Notice 85-10, these would be correct statements. It does not appear, however, that clarity would be enhanced by their addition. These items are clearly not required to comply with the new standards due to their absence in § 25.853(a-1). The other commenter suggests that the word "component" should be deleted from § 121.312(5) and (6).

As the reason for this deletion, the commenter repeats a statement in the preamble to Notice 85-10 that replacement of individual components on a piece-meal basis will not significantly increase the level of safety and might result in incompatibility of parts. This, of course, does reflect the intent of the rule; however, the current wording does not imply that individual components would have to meet the new standards, and the phrase "components subject to § 25.853(a-1)" is necessary to exclude the components not subject to § 25.853(a-1). For example, whether the seats or flooring is replaced is not relevant to a determination that there is a "substantially complete replacement" of the components that must meet these flammability standards.

One commenter requests clarification of whether galley inserts such as oven racks, standard units, meal trolleys, waste trolleys, etc., must meet the new standards. Generally, such items do not have to meet the new standards because they are not exposed when they are stowed. There are, however, interior arrangements in which major surfaces of such items are exposed even when they are stowed. If the exposed surfaces of such units, individually or collectively, comprise a surface area that is significant from a flammability standpoint, the exposed surfaces must comply with the new flammability standards.

The statement in the preamble to Amendments 25-61 and 121-189 that "components removed from one airplane, refurbished and installed in another airplane on a rotational basis would have to meet the new flammability requirements" is characterized by one commenter as a new requirement that was added in the final rule without being proposed in Notice 85-10. The commenter appears to be confusing the word "replacement" with the qualified term "essentially complete replacement." As discussed in the preamble, interior components that are removed, refurbished, and reinstalled in the same airplane would not be "replaced." Because they would not be replaced, § 121.312(a)(6) does not require these components to meet the new standards, regardless of whether they constitute all, or essentially all, of the cabin interior components subject to § 25.853(a-1). If, on the other hand, the refurbished components installed in the airplane are not those removed earlier from that airplane, the components removed from the airplane have, by definition, been "replaced." The fact that certain components have been "replaced" does not, in itself, mean that the newly installed components have to meet the new standards. As discussed above, whether the components that "replace" the removed components have to meet the new standards depends on whether there is an "essentially complete replacement" of the cabin interior components.

The same commenter states that the FAA failed to comply with the requirements of § 604(a)(2) and (3) of the Administrative Procedures Act (APA) by not discussing significant comments and alternatives provided by parties affected by the Notice. The commenter lists a number of comments which, according to the commenter, were not discussed. Actually, the listed comments were discussed in varying depths. That the FAA did not accept the commenter's position does not mean that the comments were not considered. The commenter must recognize that when comments are in conflict with other comments or with other information available to the FAA, the FAA must accept the position deemed to have the most credence. The commenter is particularly disturbed that the alternative standards proposed in the joint ATA/AIA petition for further rulemaking were not evaluated and addressed in the preamble to Amendments 25-61 and 121-189. Although the petitioners had informally indicated their intent to petition for further rulemaking earlier, neither the petition nor any supporting data were received prior to December 24, 1985, when the rulemaking was completed and forwarded from the FAA for executive review. Delaying the rulemaking until the petition was received would have resulted in an unwarranted delay in the implementation of the new safety standards. Nevertheless, the FAA did provide for further consideration of the matter by requesting the additional comments addressed in this document.

One commenter believes that requiring compliance with interim standards within 2 years and with the definitive standards within 4 years will result in greater costs than requiring compliance with the definitive standards within 2 years, as originally proposed. As the basis for this belief, the commenter states that interior materials meeting the interim standards will not be acceptable to airlines taking delivery both before and after the interim period because of costly complex spares and maintenance problems.

Compliance with the interim standards is not expected to present a significant burden in itself, because, as noted above, there are few interior materials used in current production of transport category airplanes that do not have heat release characteristics that are better than the interim standards. As discussed in the preamble to Amendments 25-61 and 121-189, the interim standards were established primarily to prevent any degradation in the present level of safety due to increased use of materials found to be especially flammable. While some airlines may choose to voluntarily use components that meet the definitive standards in airplanes produced during the interim period, it does not appear that their choice would be due to spares and maintenance considerations. Typically, the interior components that must meet these standards do not fail unexpectedly in service. Rather, they deteriorate on a slow, predictable basis due to wear and tear. Even when deteriorated, such components are frequently refurbished and reused. Consequently, there is no need to maintain an extensive supply of spares for such components; and having two interior configurations would not significantly increase the number of spares needed. It appears that a more likely reason for voluntarily using components that meet the definitive standards during the interim period would be the safety benefits that will result from their use. In any event, costs due to voluntary compliance are not attributable to this rulemaking.

The only comments received concerning the further adjustments in the test apparatus and procedures recommended by the FAA Technical Center are outlined in the notice of reopening of the comment period are favorable. These adjustments are, therefore, adopted as proposed.

Since the time Amendment 25-61 was adopted, questions have been raised concerning the applicability of the type certification standards contained in that amendment to cabin windows and clear vision panels in cabin partitions, galleys (including galley carts and other rotatable galley equipment), and isolated compartments. The FAA will address these issues in separate rulemaking or advisory action.

Other nonsubstantive editorial changes have also been made for clarity. In particular, § 121.312(a)(1), (2), (5), and (6) have been changed to clarify that only compliance with § 25.853(a-1) is required, not § 25.853 in its entirety. Minor nonsubstantive changes have also been made in the test procedures to more closely reflect the manner in which the tests are actually conducted.

Regulatory Evaluation

I. *Evaluation of Cost and Benefits*

Two commenters reiterate their earlier contentions that the actual cost impact will be greater than the value estimated in the original regulatory evaluation for these amendments. The FAA considers these comments worthy of further discussion. A revised regulatory evaluation reflecting the issues raised by these comments has been placed in the docket, and the revisions are summarized below.

The contentions of the commenters are based, to a large extent, on the premise that no suitable candidate materials will be available in time to comply with the new standards. The FAA is aware of some materials that meet the new standards and are currently in use in the cabins of transport category airplanes. Other materials are available for such use. As discussed above, § 121.312(a) is amended to provide relief for the few unique components for which timely compliance cannot be achieved. The rule has, therefore, been revised to accommodate their concerns to the limited extent to which the FAA concurs with those comments.

It is difficult for either the FAA or the manufacturing industry to estimate the compliance costs of the new flammability standards with great precision. The development of the new or modified manufacturing processes found necessary or desirable for the fabrication of compliant interior components involves experimentation with unfamiliar applications of relatively new materials. Estimates by manufacturers can, therefore, be expected to be extremely conservative because of this uncertainty. While the FAA does not consider the cost of compliance to be nearly as great as the manufacturers' estimates, the FAA does acknowledge that the adoption of these new flammability standards will be more costly than originally estimated. Due to this same uncertainty, it is difficult to predict the exact extent of the difference between the amount originally estimated and the actual cost. Nevertheless, the FAA still considers that the new standards are in the best overall interest of the public. It is difficult to separate the incremental costs of the rule from the cost of the ongoing research and development efforts of materials suppliers, interior manufacturers, and airplane manufacturers. Indeed, in its regulatory evaluation, the FAA anticipated that approximately 48 percent of the U.S. airplane fleet would have met the new standards voluntarily by the year 2000; therefore, no benefits were attributed to the rule for those airplanes. This voluntary action would have a similar mitigating effect on the costs of the rule. This mitigating effect was not fully recognized by the commenters. The rulemaking action of the FAA will expedite the movement toward improved flammability characteristics for airplane interiors that industry has been pursuing in recent years.

Furthermore, the FAA only estimated potential benefits that could be realized by U.S. air carriers. United States manufacturers, however, included production costs for future airplane deliveries to foreign airlines in their cost estimates. Consequently, these estimates were excessive, even after allowance is made for airplanes that will be delivered by foreign manufacturers to U.S. air carriers.

Additionally, the FAA estimate of benefits attributable to the rule was extremely conservative. The benefits were estimated using a value of only $650 thousand per statistical fatality avoided. The Department of Transportation currently advocates a *minimum* value of one million dollars per statistical fatality avoided. The FAA originally estimated that an average of only about nine lives could potentially be saved per year if all large transport category airplanes operated by U.S. air carriers were equipped with interiors that have improved flammability characteristics as a result of both voluntary and FAA mandated actions. This estimate, however, was excessively low because of a misinterpretation of the data used in its derivation. The estimate should have been that, on average, from nine to sixteen lives could potentially be saved per year from both voluntary and FAA mandated actions, growing as traffic activity, and consequently passenger exposure, increases over time. The FAA estimated that the rulemaking itself would contribute to the realization of these potential safety improvements at a very slow pace, with the cumulative share attributable to the rulemaking increasing in annual increments of three percent from zero through 1988 to only 36 percent by the year 2000, resulting in a total of about 30 potential fatalities avoided. Thus, any appreciable benefit from the FAA action would not be realized until very late in the analysis period. Furthermore, the most substantial benefits would not be realized until well in to the future, far beyond the 15 year analysis period used in the FAA regulatory evaluation. Nevertheless, this is a long term problem requiring a long term solution; and, to achieve the safety objective, immediate action is necessary.

One final point must be made with respect to the evaluation of benefits. Although estimated benefits have been based upon average annual values in the evaluation to reflect the fact that an accident could occur at any time during the analysis period, the benefits of the rule will, in all likelihood, be realized in a more random, erratic manner, and in much larger increments. Thus, this rule could prevent numerous casualties in an accident ocurring relatively soon after its implementation, or in an accident that does not occur until twenty to thirty years later. This rulemaking is intended to prevent the worst case scenario.

Some trade association commenters estimated that the cost of the rule to its members would be approximately $400 million through 1999, or about $300 million when discounted to the present. The FAA has reviewed those estimates and has concluded that they are somewhat high. The FAA considers that the cost to U.S. firms attributable to regulatory action would not exceed about $250 million through 1999, or about $175 million when discounted to the present. The cost per fatality avoided (discounted present value), based upon saving 30 lives during the analysis period, would be approximately $5.8 million. Although this cost per fatality avoided may seem somewhat high, it must be remembered that this rulemaking action represents only the beginning of a long term solution, and that many of the benefits of the improved flammability standards will not be realized until long after the analysis period. Further, to put the costs of this rule into a more practical perspective, the cost per U.S. enplanement would only be on the order of ten cents when annualized into the future using a capital recovery factor, and divided by the number of enplanements forecast for U.S. air carriers in future years. (The cost per enplanement would be even lower if future worldwide enplanements were considered.) Ten cents per enplanement is far below any meaningful threshold of perception by the typical airline passenger—the ultimate bearer of the cost of this rulemaking.

The present amendments involve minor refinements in the test procedures and apparatus required to demonstrate compliance with the standards adopted in the 1986 final rule for materials used in the cabins of certain transport category airplanes, an additional requirement for smoke testing, and a provision that would allow deviations to be granted under special circumstances for those few components for which timely compliance cannot be achieved.

The refinements in the test apparatus and procedures are intended only to improve the repeatability of test results from one test run to another and from one laboratory to another. These refinements do not involve any changes in the heat release standards adopted in Amendment Nos. 25-61 and 121-189, and therefore will not affect those materials found to be acceptable under the new standards. The cost of these refinements is only a few hundred dollars per test apparatus.

The new requirement for smoke testing is not expected to be very costly because most airplane manufacturers and the larger firms that manufacture aircraft interiors already conduct such testing routinely as part of their procurement procedures. Some additional expense will be incurred, however, as a result of conducting these tests to meet a formal FAA certification requirement rather than for less formal purposes. Further, there are approximately a half dozen smaller firms that fabricate cabin interior retrofit kits and most of these firms will find it necessary to obtain a smoke test chamber. This equipment can be acquired for about $30,000 per unit. However, because those materials meeting the recently adopted heat release standards also meet the new smoke standards, the smoke test will not affect those materials found to be acceptable under the new heat release standards. Therefore, no costs will be incurred as a result of the need to change materials to meet the smoke test requirements.

Finally, the deviation authority is intended to provide relief to operators only *after* the FAA has determined that special circumstances exist. Because this provision is transitional and will involve relatively few components, any impacts that may result are expected to be minimal.

II. *Regulatory Flexibility Act Determination*

A Final Regulatory Flexibility Determination was made in compliance with the Regulatory Flexibility Act. The original conclusion that the amendment would not result in a significant economic impact on a substantial number of small entities is not altered by the revised cost estimates or by the present amendment. The airframe manufacturers affected by the amendments in Part 25 are not small entities. Small entities that conduct operations under Part 121 are defined by FAA Order 2100.14A, *Regulatory Flexibility Criteria and Guidance*, as operators that own nine or fewer aircraft. Most small entity operators typically use airplanes at the smaller end of the airplane size range found in Part 121 operations, and therefore would use the least expensive new interiors and interior replacement kits. Consequently, any incremental costs resulting from the amendments to Part 121 are not expected to be burdensome, especially for existing airplanes because the interiors of these airplanes are replaced very infrequently, and the amended rule only requires that the new standards be met at the first substantially complete replacement of the cabin interior. Finally, the only small entities that could potentially be affected by the present amendments are the small manufacturers of interior retrofit kits that might find it necessary to obtain smoke test chambers. Order 2100.14A establishes the criteria for a "a substantial number of small entities" as "a number which is not less than eleven and which is more than one-third of the small entities subject to a proposed or existing rule." Because there are only about a half dozen smaller firms that fabricate retrofit kits (and some of these may even be too large to be considered small entities under Order 2100.14A), there are less than the eleven firms necessary to meet the "substantial number" criteria. Therefore, the FAA has determined that both the previous and the present amendments will not result in a significant economic impact on a substantial number of small entities.

III. *International Trade Assessment*

This amendment will have no impact on trade opportunities for both U.S. firms doing business overseas and foreign firms doing business in the U.S., as there are no significant benefits or costs. Also, airplanes newly manufactured for the U.S. market will have to comply with the rules, regardless of whether they are made by a U.S. or a foreign manufacturer.

Federalism Implications

The regulations adopted herein do not have substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. Thus, in accordance with Executive Order 12612, it is determined that such a regulation does not have federalism implications warranting the preparation of a Federalism Assessment.

CONCLUSION: For the reasons discussed earlier in the preamble, the FAA has determined that this regulation is not considered to be major under Executive Order 12291. The FAA has determined that this action is significant under DOT Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). In addition, the FAA certifies that this rule does not have a significant economic effect on a substantial number of small entities under the criteria of the Regulatory Flexibility Act, since none would be affected. A regulatory evaluation of this action, including a Regulatory Flexibility Determination and a Trade Impact Assessment, has been prepared for this regulation and has been placed in the docket. A copy of this evaluation may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Adoption of the Amendment

Accordingly, Parts 25 and 121 of the Federal Aviation Regulations (FAR), 14 CFR Parts 25 and 121, are amended effective September 26, 1988.

The authority citation for Part 25 continues to read as follows:

Authority: 49 U.S.C. 1344, 1354(a), 1355, 1421, 1423, 1424, 1425, 1428, 1429, 1430; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

Part 25—Airworthiness Standards: Transport Category Airplanes

Subpart A—General

§ 25.1 Applicability.

(a) This Part prescribes airworthiness standards for the issue of type certificates, and changes to those certificates, for transport category airplanes.

(b) Each person who applies under Part 21 for such a certificate or change must show compliance with the applicable requirements in this Part.

§ 25.2 Special retroactive requirements.

Notwithstanding §§ 21.17 and 21.101 of this chapter and irrespective of the date of application each applicant for a type certificate and each applicant for a supplemental-type certificate (or an amendment to a type certificate) involving an increase in passenger seating capacity to a total greater than that for which the airplane has been type certificated, must show:

(a) After October 23, 1967, that the airplane concerned meets the requirements of §§ 25.783(g), 25.803(c)(2) through (9), 25.803(d), 25.807(a), (c), and (d), 25.809(f) and (h), 25.811(a), (b), (d), (e), (f) and (g), 25.812(a)(1), (b), (c), (d), (e), (h), (i), (j), and (k)(1) and (2), 25.813(a), (b), and (c), 25.815, 25.817, 25.853(a) and (b), 25.855(a), 25.993(f), and 25.1359(c), in effect on October 24, 1967, or June 20, 1968, and

(b) After April 24, 1969, that the airplane concerned meets the requirements of §§ 25.721(d), 25.803(e), 25.811(c), 25.812(a)(2), (f), (g), and (k)(3) in effect on October 24, 1967; and

(c) After April 23, 1969, that the airplane concerned meets the requirements of § 25.785(c) in effect either prior to or on that date; and

(d) After April 23, 1969, that the airplane concerned meets the requirements of §§ 25.803(b) and 25.803(c)(1) in effect on that date.

Subpart B—Flight

GENERAL

§ 25.21 Proof of compliance.

(a) Each requirement of this subpart must be met at each appropriate combination of weight and center of gravity within the range of loading conditions for which certification is requested. This must be shown—

(1) By tests upon an airplane of the type for which certification is requested, or by calculations based on, and equal in accuracy to, the results of testing; and

(2) By systematic investigation of each probable combination of weight and center of gravity, if compliance cannot be reasonably inferred from combinations investigated.

(b) If there is less than a 2 knot difference in the forward and rearward c.g. stalling speeds, the flying qualities may be based upon the forward c.g. stalling speeds.

(c) The controllability, stability, trim, and stalling characteristics of the airplane must be shown for each altitude up to the maximum expected in operation.

(d) The following general tolerances from specified values are allowed during flight testing. However, greater tolerances may be allowed in particular tests. These tolerances are plus or minus variations unless otherwise noted in the particular test:

Item	*Tolerance*
Weight	+5%, −10%.
Critical items affected by weight.	+5%, −1%.
C.G.	7% total travel.

Item	*Tolerance*
Airspeed	3 knots or 3%, whichever is higher.
Power	5%.
Wind (takeoff and landing tests).	As low as possible but not to exceed approximately 12% V_{S_1} or 10.0 knots, whichever is lower, along the runway surface.

(e) If compliance with the flight characteristics requirements is dependent upon a stability augmentation system or upon any other automatic or power-operated system, compliance must be shown with §§ 25.671 and 25.672.

(f) In meeting the requirements of §§ 25.105(d), 25.125, 25.233, and 25.237, the wind velocity must be measured at a height of 10 meters above the surface, or corrected for the difference between the height at which the wind velocity is measured and the 10-meter height.

§ 25.23 Load distribution limits.

(a) Ranges of weights and centers of gravity within which the airplane may be safely operated must be established. If a weight and center of gravity combination is allowable only within certain load distribution limits (such as spanwise) that could be inadvertently exceeded, these limits and the corresponding weight and center of gravity combinations must be established.

(b) The load distribution limits may not exceed—

(1) The selected limits:

(2) The limits at which the structure is proven; or

(3) The limits at which compliance with each applicable flight requirement of this subpart is shown.

§ 25.25 Weight limits.

(a) *Maximum weights.* Maximum weights corresponding to the airplane operating conditions (such as ramp, ground or water taxi, takeoff, en route, and landing) environmental conditions (such as altitude and temperature), and loading conditions (such as zero fuel weight, center of gravity position and weight distribution) must be established so that they are not more than—

(1) The highest weight selected by the applicant for the particular conditions;

(2) The highest weight at which compliance with each applicable structural loading and flight requirement is shown, except that for airplanes equipped with standby power rocket engines the maximum weight must not be more than the highest weight established in accordance with Appendix E of this part; or

[(3)] The highest weight at which compliance is shown with the certification requirements of Part 36 of this chapter.]

(b) *Minimum weight.* The minimum weight (the lowest weight at which compliance with each applicable requirement of this part is shown) must be established so that it is not less than—

(1) The lowest weight selected by the applicant;

(2) The design minimum weight (the lowest weight at which compliance with each structural loading condition of this part is shown); or

(3) The lowest weight at which compliance with each applicable flight requirement is shown.

§ 25.27 Center of gravity limits.

The extreme forward and the extreme aft center of gravity limitations must be established for each practicably separable operating condition. No such limit may lie beyond—

(a) The extremes selected by the applicant;

(b) The extremes within which the structure is proven; or

(c) The extremes within which compliance with each applicable flight requirement is shown.

§ 25.29 Empty weight and corresponding center of gravity.

(a) The empty weight and corresponding center of gravity must be determined by weighing the airplane with—

(1) Fixed ballast;

(2) Unusable fuel determined under § 29.959; and

(3) Full operating fluids, including—

(i) Oil;

(ii) Hydraulic fluid; and

(iii) Other fluids required for normal operation of airplane systems, except potable water, lavatory precharge water, and water intended for injection in the engines.

(b) The condition of the airplane at the time of determining empty weight must be one that is well defined and can be easily repeated.

§ 25.31 Removable ballast.

Removable ballast may be used in showing compliance with the flight requirements of this subpart.

§ 25.33 Propeller speed and pitch limits.

(a) The propeller speed and pitch must be limited to values that will ensure—

(1) Safe operation under normal operating conditions; and

[(2) Compliance with the performance requirements in §§ 25.101 through 25.125.]

(b) There must be a propeller speed limiting means at the governor. It must limit the maximum possible governed engine speed to a value not exceeding the maximum allowable r.p.m.

(c) The low pitch blade stop, or other means used to limit the low pitch position of the propeller blades, must be set so that the engine speed does not exceed 103 percent of the maximum allowable engine r.p.m. with—

(1) The propeller blades at the low pitch limit and governor inoperative; and

(2) Takeoff manifold pressure with the airplane stationary under standard atmospheric conditions.

§§ 25.45 thru 25.75 [Deleted]

PERFORMANCE

§ 25.101 General

(a) Unless otherwise prescribed, airplanes must meet the applicable performance requirements of this subpart for ambient atmospheric conditions and still air.

(b) The performance, as affected by engine power or thrust, must be based on the following relative humidities:

(1) For turbine engine powered airplanes, a relative humidity of—

(i) 80 percent, at and below standard temperatures; and

(ii) 34 percent, at and above standard temperatures plus 50 degrees F.

Between these two temperatures, the relative humidity must vary linearly.

(2) For reciprocating engine powered airplanes, a relative humidity of 80 percent in a standard atmosphere. Engine power corrections for vapor pressure must be made in accordance with the following table:

Altitude H (ft.)	Vapor pressure e (In. Hg.)	Specific humidity w (Lb. moisture per lb. dry air)	Density ratio $\sigma = \frac{\varrho}{0.0023769}$
0	0.403	0.00849	0.99508
1,000	.354	.00773	.96672
2,000	.311	.00703	.93895
3,000	.272	.00638	.91178
4,000	.238	.00578	.88514
5,000	.207	.00523	.85910
6,000	.1805	.00472	.83361
7,000	.1566	.00425	.80870
8,000	.1356	.00382	.78434
9,000	.1172	.00343	.76053
10,000	.1010	.00307	.73722
15,000	.0463	.001710	.62868
20,000	.01978	.000896	.53263
25,000	.00778	.000436	.44806

(c) The performance must correspond to the propulsive thrust available under the particular ambient atmospheric conditions, the particular flight condition, and the relative humidity specified in paragraph (b) of this section. The available propulsive thrust must correspond to engine power or thrust, not exceeding the approved power or thrust, less—

(1) Installation losses; and

(2) The power or equivalent thrust absorbed by the accessories and services appro-

priate to the particular ambient atmospheric conditions and the particular flight condition.

(d) Unless otherwise prescribed, the applicant must select the takeoff, en route, approach, and landing configurations for the airplane.

(e) The airplane configurations may vary with weight, altitude, and temperature, to the extent they are compatible with the operating procedures required by paragraph (f) of this section.

(f) Unless otherwise prescribed, in determining the accelerate-stop distances, takeoff flight paths, takeoff distances, and landing distances, changes in the airplane's configuration, speed, power, and thrust, must be made in accordance with procedures established by the applicant for operation in service.

(g) Procedures for the execution of balked landings and missed approaches associated with the conditions prescribed in §§ 25.119 and 25.121(d) must be established.

(h) The procedures established under paragraphs (f) and (g) of this section must—

(1) Be able to be consistently executed in service by crews of average skill;

(2) Use methods or devices that are safe and reliable; and

(3) Include allowance for any time delays, in the execution of the procedures, that may reasonably be expected in service.

§ 25.103 Stalling speed.

(a) V_S is the calibrated stalling speed, or the minimum steady flight speed, in knots, at which the airplane is controllable, with—

(1) Zero thrust at the stalling speed, or, if the resultant thrust has no appreciable effect on the stalling speed, with engines idling and throttles closed;

(2) Propeller pitch controls (if applicable) in the position necessary for compliance with subparagraph (1) of this paragraph and the airplane in other respects (such as flaps and landing gear) in the condition existing in the test in which V_S is being used;

(3) The weight used when V_S is being used as a factor to determine compliance with a required performance standard; and

(4) The most unfavorable center of gravity allowable.

(b) The stalling speed V_S is the minimum speed obtained as follows:

(1) Trim the airplane for straight flight at any speed not less than 1.2 V_S or more than 1.4 V_S. At a speed sufficiently above the stall speed to ensure steady conditions, apply the elevator control at a rate so that the airplane speed reduction does not exceed one knot per second.

(2) Meet the flight characteristics provisions of § 25.203.

§ 25.105 Takeoff.

(a) The takeoff speeds described in § 25.107, the accelerate-stop distance described in § 25.109, the takeoff path described in § 25.111, and the takeoff distance and takeoff run described in § 25.113, must be determined—

(1) At each weight, altitude, and ambient temperature within the operational limits selected by the applicant; and

(2) In the selected configuration for takeoff.

(b) No takeoff made to determine the data required by this section may require exceptional piloting skill or alertness.

(c) The takeoff data must be based on—

(1) A smooth, dry, hard-surfaced runway, in the case of land planes and amphibians;

(2) Smooth water, in the case of seaplanes and amphibians; and

(3) Smooth, dry snow, in the case of skiplanes.

(d) The takeoff data must include, within the established operational limits of the airplane, the following operational correction factors:

(1) Not more than 50 percent of nominal wind components along the takeoff path opposite to the direction of takeoff, and not less than 150 percent of nominal wind components along the takeoff path in the direction of takeoff.

(2) Effective runway gradients.

[§ 25.107 Takeoff speeds.

[(a) V_1 must be established in relation to V_{EF} as follows:

[(1) V_{EF} is the calibrated airspeed at which the critical engine is assumed to fail. V_{EF} must be selected by the applicant, but may not be less than V_{MCG} determined under § 25.149(e).

[(2) V_1, in terms of calibrated airspeed, is the takeoff decision speed selected by the applicant; however, V_1 may not be less than V_{EF} plus the speed gained with the critical engine inoperative during the time interval between the instant at which the critical engine is failed, and the instant at which the pilot recognizes and reacts to the engine failure, as indicated by the pilot's application of the first retarding means during accelerate-stop tests.]

(b) $V_{2\,min}$, in terms of calibrated airspeed, may not be less than—

(1) 1.2 V_S for—

(i) Two-engine and three-engine turbopropeller and reciprocating engine powered airplanes; and

(ii) Turbojet powered airplanes without provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed;

(2) 1.15 V_S for—

(i) Turbopropeller and reciprocating engine powered airplanes with more than three engines; and

(ii) Turbojet powered airplanes with provisions for obtaining a significant reduction in the one-engine-inoperative power-on stalling speed; and

(3) 1.10 times V_{MC} established under § 25.149.

(c) V_2, in terms of calibrated airspeed, must be selected by the applicant to provide at least the gradient of climb required by § 25.121(b) but may not be less than—

(1) $V_{2\,min}$; and

(2) V_R plus the speed increment attained (in accordance with § 25.111(c)(2)) before reaching a height of 35 feet above the takeoff surface.

[(d) V_{MU} is the calibrated airspeed at and above which the airplane can safely lift off the ground, and continue the takeoff. V_{MU} speeds must be selected by the applicant throughout the range of thrust-to-weight ratios to be certificated. These speeds may be established from free air data if these data are verified by ground takeoff tests.]

(e) V_R, in terms of calibrated airspeed, must be selected in accordance with the conditions of subparagraphs (1) through (4) of this paragraph:

(1) V_R may not be less than—

(i) V_1;

(ii) 105 percent of V_{MC};

(iii) The speed (determined in accordance with § 25.111(c)(2)) that allows reaching V_2 before reaching a height of 35 feet above the takeoff surface; or

[(iv) A speed that, if the airplane is rotated at its maximum practicable rate, will result in a V_{LOF} of not less than 110 percent of V_{MU} in the all-engines-operating condition and not less than 105 percent of V_{MU} determined at the thrust-to-weight ratio corresponding to the one-engine-inoperative condition.]

(2) For any given set of conditions (such as weight, configuration, and temperature), a single value of V_R, obtained in accordance with this paragraph, must be used to show compliance with both the one-engine-inoperative and the all-engines-operating takeoff provisions.

(3) It must be shown that the one-engine-inoperative takeoff distance, using a rotation speed of 5 knots less than V_R established in accordance with subparagraphs (1) and (2) of this paragraph, does not exceed the corresponding one-engine-inoperative takeoff distance using the established V_R. The takeoff distances must be determined in accordance with § 25.113(a)(1).

(4) Reasonably expected variations in service from the established takeoff procedures for the operation of the airplane (such as over-rotation of the airplane and out-of-trim conditions) may not result in unsafe flight characteristics or in marked increases

in the scheduled takeoff distances established in accordance with § 25.113(a).

(f) V_{LOF} is the calibrated airspeed at which the airplane first becomes airborne.

[§ 25.109 Accelerate-stop distance.

[(a) The accelerate-stop distance is the greater of the following distances:

[(1) The sum of the distances necessary to—

[(i) Accelerate the airplane from a standing start to V_{EF} with all engines operating;

[(ii) Accelerate the airplane from V_{EF} to V_1 and continue the acceleration for 2.0 seconds after V_1 is reached, assuming the critical engine fails at V_{EF}; and

[(iii) Come to a full stop from the point reached at the end of the acceleration period prescribed in paragraph (a)(1)(ii) of this section, assuming that the pilot does not apply any means of retarding the airplane until that point is reached and that the critical engine is still inoperative.

[(2) The sum of the distances necessary to—

[(i) Accelerate the airplane from a standing start to V_1 and continue the acceleration for 2.0 seconds after V_1 is reached with all engines operating; and

[(ii) Come to a full stop from the point reached at the end of the acceleration period prescribed in paragraph (a)(2)(i) of this section, assuming that the pilot does not apply any means of retarding the airplane until that point is reached and that all engines are still operating.]

(b) Means other than wheel brakes may be used to determine the accelerate-stop distance if that means—

(1) Is safe and reliable;

(2) Is used so that consistent results can be expected under normal operating conditions; and

(3) Is such that exceptional skill is not required to control the airplane.

(c) The landing gear must remain extended throughout the accelerate-stop distance.

(d) If the accelerate-stop distance includes a stopway with surface characteristics substantially different from those of a smooth hard-surfaced runway, the takeoff data must include operational correction factors for the accelerate-stop distance. The correction factors must account for the particular surface characteristics of the stopway and the variations in these characteristics with seasonal weather conditions (such as temperature, rain, snow, and ice) within the established operational limits.

§ 25.111 Takeoff path.

(a) The takeoff path extends from a standing start to a point in the takeoff at which the airplane is 1,500 feet above the takeoff surface, or at which the transition from the takeoff to the en route configuration is completed and a speed is reached at which compliance with § 25.121(c) is shown, whichever point is higher. In addition—

(1) The takeoff path must be based on the procedures prescribed in § 25.101(c);

(2) The airplane must be accelerated on the ground to [V_{EF}], at which point the critical engine must be made inoperative and remain inoperative for the rest of the takeoff; and

(3) After reaching [V_{EF}], the airplane must be accelerated to V_2.

(b) During the acceleration to speed V_2, the nose gear may be raised off the ground at a speed not less than V_R. However, landing gear retraction may not be begun until the airplane is airborne.

(c) During the takeoff path determination in accordance with paragraphs (a) and (b) of this section—

(1) The slope of the airborne part of the takeoff path must be positive at each point;

(2) The airplane must reach V_2 before it is 35 feet above the takeoff surface and must continue at a speed as close as practical to, but not less than V_2, until it is 400 feet above the takeoff surface;

(3) At each point along the takeoff path, starting at the point at which the airplane reaches 400 feet above the takeoff surface, the available gradient of climb may not be less than—

(i) 1.2 percent for two-engine airplanes;

(ii) 1.5 percent for three-engine airplanes; and

(iii) 1.7 percent for four-engine airplanes; and

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[(4) Except for gear retraction and propeller feathering, the airplane configuration may not be changed, and no change in power or thrust that requires action by the pilot may be made, until the airplane is 400 feet above the takeoff surface.]

(d) The takeoff path must be determined by a continuous demonstrated takeoff or by synthesis from segments. If the takeoff path is determined by the segmental method—

(1) The segments must be clearly defined and must be related to the distinct changes in the configuration, power or thrust, and speed;

(2) The weight of the airplane, the configuration, and the power or thrust must be constant throughout each segment and must correspond to the most critical condition prevailing in the segment;

(3) The flight path must be based on the airplane's performance without ground effect; and

(4) The takeoff path data must be checked by continuous demonstrated takeoffs up to the point at which the airplane is out of ground effect and its speed is stabilized, to ensure that the path is conservative relative to the continuous path.

The airplane is considered to be out of the ground effect when it reaches a height equal to its wing span.

(e) For airplanes equipped with standby power rocket engines, the takeoff path may be determined in accordance with section II of Appendix E.

§ 25.113 Takeoff distance and takeoff run.

(a) Takeoff distance is the greater of—

(1) The horizontal distance along the takeoff path from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, determined under § 25.111; or

(2) 115 percent of the horizontal distance along the takeoff path, with all engines operating, from the start of the takeoff to the point at which the airplane is 35 feet above the takeoff surface, as determined by a procedure consistent with § 25.111.

(b) If the takeoff distance includes a clearway, the takeoff run is the greater of—

(1) The horizontal distance along the takeoff path from the start of the takeoff to a point equidistant between the point at which V_{LOF} is reached and the point at which the airplane is 35 feet above the takeoff surface, as determined under § 25.111; or

(2) 115 percent of the horizontal distance along the takeoff path, with all engines operating, from the start of the takeoff to a point equidistant between the point at which V_{LOF} is reached and the point at which the airplane is 35 feet above the takeoff surface, determined by a procedure consistent with § 25.111.

§ 25.115 Takeoff flight path.

(a) The takeoff flight path begins 35 feet above the takeoff surface at the end of the takeoff distance determined in accordance with § 25.113(a).

(b) The net takeoff flight path data must be determined so that they represent the actual takeoff flight paths (determined in accordance with § 25.111 and with paragraph (a) of this section) reduced at each point by a gradient of climb equal to—

(1) 0.8 percent for two-engine airplanes;

(2) 0.9 percent for three-engine airplanes; and

(3) 1.0 percent for four-engine airplanes.

(c) The prescribed reduction in climb gradient may be applied as an equivalent reduction in acceleration along that part of the takeoff flight path at which the airplane is accelerated in level flight.

§ 25.117 Climb: general.

Compliance with the requirements of §§ 25.119 and 25.121 must be shown at each weight, altitude, and ambient temperature within the operational limits established for the airplane and with the most unfavorable center of gravity for each configuration.

§ 25.119 Landing climb: all-engine-operating.

In the landing configuration, the steady gradient of climb may not be less than 3.2 percent, with—

(a) The engines at the power or thrust that is available eight seconds after initiation of movement of the power or thrust controls from the minimum flight idle to the takeoff position; and

(b) A climb speed of not more than 1.3 V_S.

§ 25.121 Climb: one-engine-inoperative.

(a) *Takeoff; landing gear extended.* In the critical takeoff configuration existing along the flight path (between the points at which the airplane reaches V_{LOF} and at which the landing gear is fully retracted) and in the configuration used in § 25.111 but without ground effect, the steady gradient of climb must be positive for two-engine airplanes, and not less than 0.3 percent for three-engine airplanes or 0.5 percent for four-engine airplanes, at V_{LOF} and with—

(1) The critical engine inoperative and the remaining engines at the power or thrust available when retraction of the landing gear is begun in accordance with § 25.111 unless there is a more critical power operating condition existing later along the flight path but before the point at which the landing gear is fully retracted; and

(2) The weight equal to the weight existing when retraction of the landing gear is begun, determined under § 25.111.

(b) *Takeoff; landing gear retracted.* In the takeoff configuration existing at the point of the flight path at which the landing gear is fully retracted, and in the configuration used in § 25.111 but without ground effect, the steady gradient of climb may not be less than 2.4 percent for two-engine airplanes, 2.7 percent for three-engine airplanes, 3.0 percent for four-engine airplanes, at V_2 and with—

(1) The critical engine inoperative, the remaining engines at the takeoff power or thrust available at the time the landing gear is fully retracted, determined under § 25.111, unless there is a more critical power operating condition existing later along the flight path but before the point where the airplane reaches a height of 400 feet above the takeoff surface; and

(2) The weight equal to the weight existing when the airplane's landing gear is fully retracted, determined under § 25.111.

(c) *Final takeoff.* In the en route configuration at the end of the takeoff path determined in accordance with § 25.111, the steady gradient of climb may not be less than 1.2 percent for two-engine airplanes, 1.5 percent for four-engine airplanes, at not less than 1.25 V_S and with—

(1) The critical engine inoperative and the remaining engines at the available maximum continuous power or thrust; and

(2) The weight equal to the weight existing at the end of the takeoff path, determined under § 25.111.

(d) *Approach.* In the approach configuration corresponding to the normal all-engines-operating procedure in which V_S for this configuration does not exceed 110 percent of the V_S for the related landing configuration, the steady gradient of climb may not be less than 2.1 percent for two-engine airplanes, 2.4 percent for three-engine airplanes, and 2.7 percent for four-engine airplanes, with—

(1) The critical engine inoperative, the remaining engines at the available takeoff power or thrust;

(2) The maximum landing weight; and

(3) A climb speed established in connection with normal landing procedures, but not exceeding 1.5 V_S.

§ 25.123 En route flight paths.

(a) For the en route configuration, the flight paths prescribed in paragraphs (b) and (c) of this section must be determined at each weight, altitude, and ambient temperature, within the operating limits established for the airplane. The variation of weight along the flight path, accounting for the progressive consumption of fuel and oil by the operating engines, may be included in the computation. The flight paths must be determined at any selected speed, with—

(1) The most unfavorable center of gravity;

(2) The critical engines inoperative;

(3) The remaining engines at the available maximum continuous power or thrust; and

(4) The means for controlling the engine-cooling air supply in the position that provides adequate cooling in the hot-day condition.

(b) The one-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient of climb of 1.1 percent for two-engine airplanes, 1.4 percent for three-engine airplanes, and 1.6 percent for four-engine airplanes.

(c) For three- or four-engine airplanes, the two-engine-inoperative net flight path data must represent the actual climb performance diminished by a gradient climb of 0.3 percent for three-engine airplanes and 0.5 percent for four-engine airplanes.

§ 25.125 Landing.

(a) The horizontal distance necessary to land and to come to a complete stop (or to a speed of approximately 3 knots for water landings) from a point 50 feet above the landing surface must be determined (for standard temperatures, at each weight, altitude, and wind within the operational limits established by the applicant for the airplane) as follows:

(1) The airplane must be in the landing configuration.

(2) A steady gliding approach, with a calibrated airspeed of not less than 1.3 V_S, must be maintained down to the 50 foot height.

(3) Changes in configuration, power or thrust, and speed, must be made in accordance with the established procedures for service operation.

(4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over, ground loop, porpoise, or water loop.

(5) The landings may not require exceptional piloting skill or alertness.

(b) For landplanes and amphibians, the landing distance on land must be determined on a level, smooth, dry, hard-surfaced runway. In addition—

(1) The pressures on the wheel braking systems may not exceed those specified by the brake manufacturer;

(2) The brakes may not be used so as to cause excessive wear of brakes or tires; and

(3) Means other than wheel brakes may be used if that means—

(i) Is safe and reliable;

(ii) Is used so that consistent results can be expected in service; and

(iii) Is such that exceptional skill is not required to control the airplane.

(c) For seaplanes and amphibians, the landing distance on water must be determined on smooth water.

(d) For skiplanes, the landing distance on snow must be determined on smooth, dry, snow.

(e) The landing distance data must include correction factors for not more than 50 percent of the nominal wind components along the landing path opposite to the direction of landing, and not less than 150 percent of the nominal wind components along the landing path in the direction of landing.

(f) If any device is used that depends on the operation of any engine, and if the landing distance would be noticeably increased when a landing is made with that engine inoperative, the landing distance must be determined with that engine inoperative unless the use of compensating means will result in a landing distance not more than that with each engine operating.

CONTOLLABILITY AND MANEUVERABILITY

§ 25.143 General.

(a) The airplane must be safely controllable and maneuverable during—

(1) Takeoff;

(2) Climb;

(3) Level flight;

(4) Descent; and

(5) Landing.

[(b) It must be possible to make a smooth transition from one flight condition to any other flight condition without exceptional piloting skill, alertness, or strength, and without danger of exceeding the airplane limit-load factor under any probable operating conditions, including—

[(1) The sudden failure of the critical engine;

[(2) For airplanes with three or more engines, the sudden failure of the second critical engine when the airplane is in the en route, approach, or landing configuration and is trimmed with the critical engine inoperative; and

[(3) Configuration changes, including deployment or retraction of deceleration devices.]

(c) If, during the testing required by paragraphs (a) and (b) of this section, marginal conditions exist with regard to required pilot strength, the "strength of pilots" limits may not exceed the limits prescribed in the following table:

Values in pounds of force as applied to the control wheel or rudder pedals.	Pitch	Roll	Yaw
For temporary application	75	60	[150]
For prolonged application	10	5	20

(d) In showing the temporary control force limitations of paragraph (c) of this section, approved operating procedures or conventional operating practices must be followed (including being as nearly trimmed as possible at the next preceding steady flight condition, except that, in the case of takeoff, the airplane must be trimmed in accordance with approved operating procedures).

(e) For the purpose of complying with the prolonged control force limitations of paragraph (c) of this section, the airplane must be as nearly trimmed as possible.

§ 25.145 Longitudinal control.

(a) It must be possible at any speed between the trim speed prescribed in § 25.49(c)(2)(i) and V_{S_1} (for reciprocating engine powered airplanes), or at any speed between the trim speed prescribed in § 25.103(b)(1) and V_S (for turbine engine powered airplanes), to pitch the nose downward so that the acceleration to this selected trim speed is prompt with—

(1) The airplane trimmed at the trim speed prescribed in § 25.49(c)(2)(i) (for reciprocating engine powered airplanes), or in § 25.103(b)(1) (for turbine engine powered airplanes);

(2) The landing gear extended;

(3) The wing flaps (i) retracted and (ii) extended; and

(4) Power (i) off and (ii) at maximum continuous power on the engines.

(b) With the landing gear extended, no change in trim control, or exertion of more than 50 pounds control force (representative of the maximum temporary force that readily can be applied by one hand) may be required for the following maneuvers:

(1) With power off, flaps retracted, and the airplane trimmed at 1.4 V_{S_1}, extend the flaps as rapidly as possible while maintaining the airspeed at approximately 40 percent above the stalling speed existing at each instant throughout the maneuver.

(2) Repeat subparagraph (1) except initially extend the flaps and then retract them as rapidly as possible.

(3) Repeat subparagraph (2) except with takeoff power.

(4) With power off, flaps retracted, and the airplane trimmed at 1.4 V_{S_1}, apply takeoff power rapidly while maintaining the same airspeed.

(5) Repeat subparagraph (4) except with flaps extended.

(6) With power off, flaps extended, and the airplane trimmed at 1.4 V_{S_1}, obtain and maintain airspeeds between 1.1 V_{S_1} and either 1.7 V_{S_1}, or V_{FE}, whichever is lower.

(c) It must be possible, without exceptional piloting skill, to prevent loss of altitude when complete retraction of the high lift devices from any position is begun during steady, straight, level flight at 1.1 V_{S_1} for propeller

power airplanes or 1.2 V_{S_1} for turbojet powered airplanes, with—

(1) Simultaneous application of not more than takeoff power taking into account the critical engine operating conditions;

(2) The landing gear extended; and

(3) The critical combinations of landing weights and altitudes.

If gated high-lift device control positions are provide, retraction must be shown from any position from the maximum landing position to the first gated position, between gated positions, and from the last gated position to the full retraction position. In addition, the first gated control position position from the landing position must correspond with the high-lift devices configuration used to establish the go-around procedure from the landing configuration. Each gated control position must require a separate and distinct motion of the control to pass through the gated position and must have features to prevent inadvertent movement of the control through the gated position.

§ 25.147 Directional and lateral control.

(a) *Directional control; general.* It must be possible, while holding the wings approximately level, to safely make reasonably sudden changes in heading in both directions. This must be shown at 1.4 V_{S_1} for heading changes up to 15° (except that the heading change at which the rudder pedal force is [150] pounds need not be exceeded), and with—

(1) The critical engine inoperative and its propeller in the minimum drag position;

(2) The power required for level flight at 1.4 V_{S_1}, but not more than maximum continuous power;

(3) The most unfavorable center of gravity;

(4) Landing gear retracted;

(5) Flaps in the approach position; and

(6) Maximum landing weight.

(b) *Directional control; airplanes with four or more engines.* Airplanes with four or more engines must meet the requirements of paragraph (a) of this section except that—

(1) The two critical engines must be inoperative with their propellers (if applicable) in the minimum drag position;

(2) The center of gravity must be in the most forward position; and

(3) The flaps must be in the most favorable climb position.

(c) *Lateral control; general.* It must be possible to make 20° banked turns, with and against the inoperative engine, from steady flight at a speed equal to 1.4 V_{S_1} with—

(1) The critical engine inoperative and its propeller (if applicable) in the minimum drag position;

(2) The remaining engines at maximum continuous power;

(3) The most unfavorable center of gravity;

(4) Landing gear (i) retracted and (ii) extended;

(5) Flaps in the most favorable climb position; and

(6) Maximum takeoff weight.

(d) *Lateral control; airplanes with four or more engines.* Airplanes with four or more engines must be able to make 20° banked turns, with and against the inoperative engines, from steady flight at a speed equal to $1.4V_{S_1}$, with maximum continuous power, and with the airplane in the configuration prescribed by paragraph (b) of this section.

(e) *Lateral control; all engines operating.* With the engines operating, roll response must allow normal maneuvers (such as recovery from upsets produced by gusts and the initiation of evasive maneuvers). There must be enough excess lateral control in sideslips (up to sideslip angles that might be required in normal operation), to allow a limited amount of maneuvering and to correct for gusts. Lateral control must be enough at any speed up to V_{FC}/M_{FC} to provide a peak roll rate necessary for safety, without excess control forces or travel.

[(b) It must be possible to make a smooth transition from one flight condition to any other flight condition without exceptional piloting skill, alertness, or strength, and without danger of exceeding the airplane limit-load factor under any probable operating conditions, including—

[(1) The sudden failure of the critical engine;

[(2) For airplanes with three or more engines, the sudden failure of the second critical engine when the airplane is in the en route, approach, or landing configuration and is trimmed with the critical engine inoperative; and

[(3) Configuration changes, including deployment or retraction of deceleration devices.]

(c) If, during the testing required by paragraphs (a) and (b) of this section, marginal conditions exist with regard to required pilot strength, the "strength of pilots" limits may not exceed the limits prescribed in the following table:

Values in pounds of force as applied to the control wheel or rudder pedals.	Pitch	Roll	Yaw
For temporary application	75	60	[150]
For prolonged application	10	5	20

(d) In showing the temporary control force limitations of paragraph (c) of this section, approved operating procedures or conventional operating practices must be followed (including being as nearly trimmed as possible at the next preceding steady flight condition, except that, in the case of takeoff, the airplane must be trimmed in accordance with approved operating procedures).

(e) For the purpose of complying with the prolonged control force limitations of paragraph (c) of this section, the airplane must be as nearly trimmed as possible.

§ 25.145 Longitudinal control.

(a) It must be possible at any speed between the trim speed prescribed in § 25.49(c)(2)(i) and V_{S_1} (for reciprocating engine powered airplanes), or at any speed between the trim speed prescribed in § 25.103(b)(1) and V_S (for turbine engine powered airplanes), to pitch the nose downward so that the acceleration to this selected trim speed is prompt with—

(1) The airplane trimmed at the trim speed prescribed in § 25.49(c)(2)(i) (for reciprocating engine powered airplanes), or in § 25.103(b)(1) (for turbine engine powered airplanes);

(2) The landing gear extended;

(3) The wing flaps (i) retracted and (ii) extended; and

(4) Power (i) off and (ii) at maximum continuous power on the engines.

(b) With the landing gear extended, no change in trim control, or exertion of more than 50 pounds control force (representative of the maximum temporary force that readily can be applied by one hand) may be required for the following maneuvers:

(1) With power off, flaps retracted, and the airplane trimmed at 1.4 V_{S_1}, extend the flaps as rapidly as possible while maintaining the airspeed at approximately 40 percent above the stalling speed existing at each instant throughout the maneuver.

(2) Repeat subparagraph (1) except initially extend the flaps and then retract them as rapidly as possible.

(3) Repeat subparagraph (2) except with takeoff power.

(4) With power off, flaps retracted, and the airplane trimmed at 1.4 V_{S_1}, apply takeoff power rapidly while maintaining the same airspeed.

(5) Repeat subparagraph (4) except with flaps extended.

(6) With power off, flaps extended, and the airplane trimmed at 1.4 V_{S_1}, obtain and maintain airspeeds between 1.1 V_{S_1} and either 1.7 V_{S_1}, or V_{FE}, whichever is lower.

(c) It must be possible, without exceptional piloting skill, to prevent loss of altitude when complete retraction of the high lift devices from any position is begun during steady, straight, level flight at 1.1 V_{S_1} for propeller power airplanes or 1.2 V_{S_1} for turbojet powered airplanes, with—

(1) Simultaneous application of not more than takeoff power taking into account the critical engine operating conditions;

(2) The landing gear extended; and

(3) The critical combinations of landing weights and altitudes.

If gated high-lift device control positions are provide, retraction must be shown from any position from the maximum landing position to the first gated position, between gated positions, and from the last gated position to the full retraction position. In addition, the first gated control position position from the landing position must correspond with the high-lift devices configuration used to establish the go-around procedure from the landing configuration. Each gated control position must require a separate and distinct motion of the control to pass through the gated position and must have features to prevent inadvertent movement of the control through the gated position.

§ 25.147 Directional and lateral control.

(a) *Directional control; general.* It must be possible, while holding the wings approximately level, to safely make reasonably sudden changes in heading in both directions. This must be shown at 1.4 V_{S_1} for heading changes up to 15° (except that the heading change at which the rudder pedal force is [150] pounds need not be exceeded), and with—

(1) The critical engine inoperative and its propeller in the minimum drag position;

(2) The power required for level flight at 1.4 V_{S_1}, but not more than maximum continuous power;

(3) The most unfavorable center of gravity;

(4) Landing gear retracted;

(5) Flaps in the approach position; and

(6) Maximum landing weight.

(b) *Directional control; airplanes with four or more engines.* Airplanes with four or more engines must meet the requirements of paragraph (a) of this section except that—

(1) The two critical engines must be inoperative with their propellers (if applicable) in the minimum drag position;

(2) The center of gravity must be in the most forward position; and

(3) The flaps must be in the most favorable climb position.

(c) *Lateral control; general.* It must be possible to make 20° banked turns, with and against the inoperative engine, from steady flight at a speed equal to 1.4 V_{S_1} with—

(1) The critical engine inoperative and its propeller (if applicable) in the minimum drag position;

(2) The remaining engines at maximum continuous power;

(3) The most unfavorable center of gravity;

(4) Landing gear (i) retracted and (ii) extended;

(5) Flaps in the most favorable climb position; and

(6) Maximum takeoff weight.

(d) *Lateral control; airplanes with four or more engines.* Airplanes with four or more engines must be able to make 20° banked turns, with and against the inoperative engines, from steady flight at a speed equal to 1.4V_{S_1}, with maximum continuous power, and with the airplane in the configuration prescribed by paragraph (b) of this section.

(e) *Lateral control; all engines operating.* With the engines operating, roll response must allow normal maneuvers (such as recovery from upsets produced by gusts and the initiation of evasive maneuvers). There must be enough excess lateral control in sideslips (up to sideslip angles that might be required in normal operation), to allow a limited amount of maneuvering and to correct for gusts. Lateral control must be enough at any speed up to V_{FC}/M_{FC} to provide a peak roll rate necessary for safety, without excess control forces or travel.

[§ 25.149 Minimum control speed.

[(a) In establishing the minimum control speeds required by this section, the method used to simulate critical engine failure must represent the most critical mode of powerplant failure with respect to controllability expected in service.]

[(b)] V_{MC} is the calibrated airspeed, at which, when the critical engine is suddenly made inoperative, it is possible to recover control of the airplane with that engine still inoperative, and maintain straight flight either with zero yaw or, at the option of the applicant, with an angle of bank of not more than 5 degrees.

[(c) V_{MC} may not exceed 1.2 V_S with—]

(1) Maximum available takeoff power or thrust on the engines;

(2) The most unfavorable center of gravity;

(3) The airplane trimmed for takeoff;

(4) The maximum sea level takeoff weight (or any lesser weight necessary to show V_{MC});

(5) The airplane in the most critical takeoff configuration existing along the flight path after the airplane becomes airborne, except with the landing gear retracted; and

(6) The airplane airborne and the ground effect negligible [; and

[(7) If applicable, the propeller of the inoperative engine—

[(i) Windmilling;

[(ii) In the most probable position for the specific design of the propeller control; or

[(iii) Feathered, if the airplane has an automatic feathering device acceptable for showing compliance with the climb requirements of § 25.121.]

(d) The rudder forces required to maintain control at V_{MC} may not exceed [150] pounds nor may it be necessary to reduce power or thrust of the operative engines. During recovery, the airplane may not assume any dangerous attitude or require exceptional piloting skill, alertness, or strength to prevent a heading change of more than 20 degrees.

[(e) V_{MCG}, the minimum control speed on the ground, is the calibrated airspeed during the takeoff run, at which, when the critical engine is suddenly made inoperative, it is possible to recover control of the airplane with the use of primary aerodynamic controls alone (without the use of nose-wheel steering) to enable the takeoff to be safely continued using normal piloting skill and rudder control forces not exceeding 150 pounds. In the determination of V_{MCG}, assuming that the path of the airplane accelerating with all engines operating is along the centerline of the runway, its path from the point at which the critical engine is made inoperative to the point at which recovery to a direction parallel to the centerline is completed may not deviate more than 30 feet laterally from the centerline at any point. V_{MCG} must be established with—

[(1) The airplane in each takeoff configuration or, at the option of the applicant, in the most critical takeoff configuration;

[(2) Maximum available takeoff power or thrust on the operating engines;

[(3) The most unfavorable center of gravity;

[(4) The airplane trimmed for takeoff; and

[(5) The most unfavorable weight in the range of takeoff weights.

[(f) V_{MCL}, the minimum control speed during landing approach with all engines operating, is the calibrated airspeed at which, when the critical engine is suddenly made inoperative, it is possible to recover control of the airplane with that engine still inoperative, and maintain straight flight either with zero yaw or, at the option of the applicant, with an angle of bank of not more than 5 degrees. V_{MCL} must be established with—

[(1) The airplane in the most critical configuration for approach with all engines operating;

[(2) The most unfavorable center of gravity;

[(3) The airplane trimmed for approach with all engines operating;

[(4) The maximum sea level landing weight or any lesser weight necessary to show V_{MCL}); and

[(5) Maximum available takeoff power or thrust on the operating engines.

[(g) For airplanes with three or more engines, $V_{MC_{L-2}}$, the minimum control speed during landing approach with one critical engine inoperative, is the calibrated airspeed at which, when a second critical engine is suddenly made inoperative, it is possible to recover control of the airplane with both engines still inoperative and maintain straight flight either with zero yaw or, at the option of the applicant, with an angle of bank of not more than 5 degrees. $V_{MC_{L-2}}$, must be established with—

[(1) The airplane in the most critical configuration for approach with the critical engine inoperative;

[(2) The most unfavorable center of gravity;

[(3) The airplane trimmed for approach with the critical engine inoperative;

[(4) The maximum sea level landing weight (or any lesser weight necessary to show $V_{MC_{L-2}}$);

[(5) The power or thrust on the operating engines required to maintain an approach path angle of 3 degrees when one critical engine is inoperative; and

[(6) The power or thrust on the operating engines rapidly changed, immediately after the second critical engine is made inoperative, from the power or thrust prescribed in paragraph (g)(5) of this section to—

[(i) Minimum available power or thrust; and

[(ii) Maximum available takeoff power or thrust.

[(h) The rudder control forces required to maintain control at V_{MC_L} and $V_{MC_{L-2}}$ may not exceed 150 pounds, nor may it be necessary to reduce the power or thrust of the operating engines. In addition, the airplane may not assume any dangerous attitudes or require exceptional piloting skill, alertness, or strength to prevent a divergence in the approach flight path that would jeopardize continued safe approach when—

[(1) The critical engine is suddenly made inoperative; and

[(2) For the determination of $V_{MC_{L-2}}$, the power or thrust on the operating engines is changed in accordance with paragraph (g)(6) of this section.]

TRIM

§ 25.161 Trim.

(a) *General.* Each airplane must meet the trim requirements of this section after being trimmed, and without further pressure upon, or movement of, either the primary controls or their corresponding trim controls by the pilot or the automatic pilot.

(b) *Lateral and directional trim.* The airplane must maintain lateral and directional trim with the most adverse lateral displacement of the center of gravity within the relevant operating limitations, during normally expected conditions of operation (including operation at any speed from 1.4 V_{S_1} to V_{MO}/M_{MO}).

(c) *Longitudinal trim.* The airplane must maintain longitudinal trim during—

(1) A climb with maximum continuous power at a speed not more than 1.4 V_{S_1}, with the landing gear retracted, and the flaps (i) retracted and (ii) in the takeoff position;

(2) A glide with power off at a speed not more than 1.4 V_{S_1}, with the landing gear extended, the wing flaps (i) retracted and (ii) extended, the most unfavorable center of gravity position approved for landing with the maximum landing weight, and with the most unfavorable center of gravity position approved for landing regardless of weight; and

(3) Level flight at any speed from 1.4 V_{S_1} to V_{MO}/M_{MO}, with the landing gear and

flaps retracted, and from 1.4 V_{S_1} to V_{LE} with the landing gear extended.

(d) *Longitudinal, directional, and lateral trim.* The airplane must maintain longitudinal, directional, and lateral trim (and for lateral trim, the angle of bank may not exceed five degrees) at 1.4 V_{S_1} during climbing flight with—

(1) The critical engine inoperative;

(2) The remaining engines at maximum continuous power; and

(3) The landing gear and flaps retracted.

(e) *Airplanes with four or more engines.* Each airplane with four or more engines must maintain trim in rectilinear flight—

(1) At the climb speed, configuration, and power required by [§ 25.123(a)] for the purpose of establishing the rate of climb;

(2) With the most unfavorable center of gravity position; and

(3) At the weight at which the two-engine-inoperative climb is equal to at least 0.013 $V_{S_0}{}^2$ at an altitude of 5,000 feet.

STABILITY

§ 25.171 General.

The airplane must be longitudinally, directionally, and laterally stable in accordance with the provisions of §§ 25.173 through 25.177. In addition, suitable stability and control feel (static stability) is required in any condition normally encountered in service, if flight tests show it is necessary for safe operation.

§ 25.173 Static longitudinal stability.

Under the conditions specified in § 25.175, the characteristics of the elevator control forces (including friction) must be as follows:

(a) A pull must be required to obtain and maintain speeds below the specified trim speed, and a push must be required to obtain and maintain speeds above the specified trim speed. This must be shown at any speed that can be obtained except speeds higher than the landing gear or wing flap operating limit speeds or V_{FC}/M_{FC}, whichever is appropriate, or lower than the minimum speed for steady unstalled flight.

(b) The airspeed must return to within 10 percent of the original trim speed for the climb, approach, and landing conditions specified in § 25.175(a), (c), and (d), and must return to within 7.5 percent of the original trim speed for the cruising condition specified in § 25.175(b), when the control force is slowly released from any speed within the range specified in paragraph (a) of this section.

(c) The average gradient of the stable slope of the stick force versus speed curve may not be less than 1 pound for each 6 knots.

(d) Within the free return speed range specified in paragraph (b) of this section, it is permissible for the airplane, without control forces, to stabilize on speeds above or below the desired trim speeds if exceptional attention on the part of the pilot is not required to return to and maintain the desired trim speed and altitude.

§ 25.175 Demonstration of static longitudinal stability.

Static longitudinal stability must be shown as follows:

(a) *Climb.* The stick force curve must have a stable slope at speeds between 85 and 115 percent of the speed at which the airplane—

(1) Is trimmed with—

(i) Wing flaps retracted;

(ii) Landing gear retracted;

(iii) Maximum takeoff weight; and

(iv) 75 percent of maximum continuous power for reciprocating engines or the maximum power or thrust selected by the applicant as an operating limitation for use during climb for turbine engines; and

(2) Is trimmed at the speed for best rate-of-climb except that the speed need not be less than 1.4 V_{S_1}.

(b) *Cruise.* Static longitudinal stability must be shown in the cruise condition as follows:

(1) With the landing gear retracted at high speed, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than 1.4 V_{S_1}, nor speeds greater than V_{FC}/M_{FC}, nor speeds that require a stick force of more than 50 pounds), with—

(i) The wing flaps retracted;

(ii) The center of gravity in the most adverse position (see § 25.27);

(iii) The most critical weight between the maximum takeoff and maximum landing weights;

(iv) 75 percent of maximum continuous power for reciprocating engines or, for turbine engines, the maximum cruising power selected by the applicant as an operating limitation (see § 25.1521), except that the power need not exceed that required at V_{MO}/M_{MO}; and

(v) The airplane trimmed for level flight with the power required in subparagraph (iv) above.

(2) With the landing gear retracted at low speed, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than 1.4 V_{S_1}, nor speeds greater than the minimum speed of the applicable speed range prescribed in subparagraph (1), nor speeds that require a stick force of more than 50 pounds), with—

(i) Wing flaps, center of gravity position, and weight as specified in subparagraph (1) of this paragraph;

(ii) Power required for level flight at a speed equal to $\frac{V_{MO}+1.4\ V_{S_1}}{2}$; and

(iii) The airplane trimmed for level flight with the power required in subparagraph (ii) above.

(3) With the landing gear extended, the stick force curve must have a stable slope at all speeds within a range which is the greater of 15 percent of the trim speed plus the resulting free return speed range, or 50 knots plus the resulting free return speed range, above and below the trim speed (except that the speed range need not include speeds less than 1.4 V_{S_1}, nor speeds greater than V_{LE}, nor speeds that require a stick force of more than 50 pounds), with—

(i) Wing flap, center of gravity position, and weight as specified in subparagraph (1);

(ii) 75 percent of maximum continuous power for reciprocating engines or, for turbine engines, the maximum cruising power selected by the applicant as an operating limitation, except that the power need not exceed that required for level flight at V_{LE}; and

(iii) The aircraft trimmed for level flight with the power required in subparagraph (ii) above.

(c) *Approach.* The stick force curve must have a stable slope at speeds between 1.1 V_{S_1} and 1.8 V_{S_1}, with—

(1) Wing flaps in the approach position;

(2) Landing gear retracted;

(3) Maximum landing weight; and

(4) The airplane trimmed at 1.4 V_{S_1} with enough power to maintain level flight at this speed.

(d) *Landing.* The stick force curve must have a stable slope and the stick force may not exceed 80 pounds, at speeds between 1.1 V_{S_0} and 1.8 V_{S_0} with—

(1) Wing flaps in the landing position;

(2) Landing gear extended;

(3) Maximum landing weight;

(4) Power or thrust off on the engines; and

(5) The airplane trimmed at 1.4 V_{S_0} with power or thrust off.

§ 25.177 Static directional and lateral stability.

(a) The static directional stability (as shown by the tendency to recover from a skid with the rudder free) must be positive for any landing gear and flap position and symmetrical power condition, at speeds from 1.2 V_{S_1} up to V_{FE}, V_{LE}, or V_{FC}/M_{FC} (as appropriate).

[(b) The static lateral stability (as shown by the tendency to raise the low wing in a sideslip with the aileron controls free and for any landing gear and flap position and symmetrical power condition) may not be negative at any airspeed (except speeds higher than V_{FE} or V_{LE}, when appropriate) in the following airspeed ranges:

[(1) From 1.2 V_{S_1} to V_{MO}/M_{MO}.

[(2) From V_{MO}/M_{MO} to V_{FC}/M_{FC} unless the Administrator finds that the divergence is—

[(i) Gradual;

[(ii) Easily recognizable by the pilot; and

[(iii) Easily controllable by the pilot.]

(c) In straight, steady, sideslips (unaccelerated forward slips) the aileron and rudder control movements and forces must be substantially proportional to the angle of sideslip, and the factor of proportionality must lie between limits found necessary for safe operation throughout the range of sideslip angles appropriate to the operation of the airplane. At greater angles, up to the angle at which full rudder control is used or a rudder pedal force of 180 pounds is obtained, the rudder pedal forces may not reverse and increased rudder deflection must produce increased angles of sideslip. Unless the airplane has a yaw indicator, there must be enough bank accompanying sideslipping to clearly indicate any departure from steady unyawed flight.

[§ 25.181 Dynamic stability.

[(a) Any short period oscillation, not including combined lateral-directional oscillations, occurring between stalling speed and maximum allowable speed appropriate to the configuration of the airplane must be heavily damped with the primary controls—

[(1) Free; and

[(2) In a fixed position.

[(b) Any combined lateral-directional oscillations ("Dutch roll") occurring between stalling speed and maximum allowable speed appropriate to the configuration of the airplane must be positively damped with controls free, and must be controllable with normal use of the primary controls without requiring exceptional pilot skill.]

STALLS

§ 25.201 Stall demonstration.

(a) Stalls must be shown in straight flight and in 30 degree banked turns with—

(1) Power off; and

(2) The power necessary to maintain level flight at 1.6 V_{S_1} (where V_{S_1} corresponds to the stalling speed with flaps in the approach position, the landing gear retracted, and maximum landing weight).

(b) In either condition required by paragraph (a) of this section, it must be possible to meet the applicable requirements of § 25.203 with—

(1) Flaps and landing gear in any likely combination of positions;

(2) Representative weights within the range for which certification is requested; and

(3) The most adverse center of gravity for recovery.

(c) The following procedure must be used to show compliance with § 25.203:

(1) With the airplane trimmed for straight flight at the speed prescribed in § 25.103(b)(1), reduce the speed with the elevator control until it is steady at slightly above stalling speed. Apply elevator control so that the speed reduction does not exceed one knot per second until (i) the airplane is stalled, or (ii) the control reaches the stop.

[(2)] As soon as the airplane is stalled, recover by normal recovery techniques.

[(d) Occurrence of stall is defined as follows:

[(1) The airplane may be considered stalled when, at an angle of attack measurably greater than that for maximum lift, the inherent flight characteristics give a clear and distinctive indication to the pilot that the airplane is stalled. Typical indications of a stall, occurring either individually or in combination, are—

[(i) A nose-down pitch that cannot be readily arrested;

[(ii) A roll that cannot be readily arrested; or

[(iii) If clear enough, a loss of control effectiveness, an abrupt change in control force or motion, or a distinctive shaking of the pilot's controls.

[(2) For any configuration in which the airplane demonstrates an unmistakable inherent aerodynamic warning of a magnitude and severity that is a strong and effective deterrent to further speed reduction, the airplane may be considered stalled when it reaches the speed at which the effective deterrent is clearly manifested.]

§ 25.203 Stall characteristics.

(a) It must be possible to produce and to correct roll and yaw by unreversed use of the aileron and rudder controls, up to the time the airplane is stalled. No abnormal nose-up pitching may occur. The longitudinal control force must be positive up to and throughout the stall. In addition, it must be possible to promptly prevent stalling and to recover from a stall by normal use of the controls.

(b) For level wing stalls, the roll occurring between the stall and the completion of the recovery may not exceed approximately 20 degrees.

(c) For turning flight stalls, the action of the airplane after the stall may not be so violent or extreme as to make it difficult, with normal piloting skill, to effect a prompt recovery and to regain control of the airplane.

§ 25.205 Stalls: critical engine inoperative.

(a) It must be possible to safely recover from a stall with the critical engine inoperative—

(1) Without applying power to the inoperative engine;

(2) With flaps and landing gear retracted; and

(3) With the remaining engines at up to 75 percent of maximum continuous power, or up to the power at which the wings can be held level with the use of maximum control travel, whichever is less.

(b) The operating engines may be throttled back during stall recovery from stalls with the critical engine inoperative.

§ 25.207 Stall warning.

(a) Stall warning with sufficient margin to prevent inadvertent stalling with the flaps and landing gear in any normal position must be clear and distinctive to the pilot in straight and turning flight.

(b) The warning may be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself. [If a warning device is used, it must provide a warning in each of the airplane configurations prescribed in paragraph (a) of this section at the speed prescribed in paragraph (c) of this section.]

(c) The stall warning must begin at a speed exceeding the stalling speed (i.e., the speed at which the airplane stalls or the minimum speed demonstrated, whichever is applicable, under the provisions of [§ 25.201(d)] by seven percent or at any lesser margin if the stall warning has enough clarity, duration, distinctiveness, or similar properties.

GROUND AND WATER HANDLING CHARACTERISTICS

§ 25.231 Longitudinal stability and control.

(a) Landplanes may have no uncontrollable tendency to nose over in any reasonably expected operating condition or when rebound occurs during landing or takeoff. In addition—

(1) Wheel brakes must operate smoothly and may not cause any undue tendency to nose over; and

(2) If a tail-wheel landing gear is used, it must be possible, during the takeoff ground run on concrete, to maintain any attitude up to thrust line level, at 80 percent of V_{S_1}.

(b) For seaplanes and amphibians, the most adverse water conditions safe for takeoff, taxiing, and landing, must be established.

§ 25.233 Directional stability and control.

(a) There may be no uncontrollable groundlooping tendency in 90° cross winds, up to a wind velocity of [20 knots or 0.2 V_{S_0}, whichever is greater, except that the wind velocity need not exceed 25 knots] at any speed at which the airplane may be expected to be operated on the ground. This may be shown while establishing the 90° cross component of wind velocity required by § 25.237.

(b) Landplanes must be satisfactorily controllable, without exceptional piloting skill or alertness, in power-off landings at normal landing speed, without using brakes or engine power to maintain a straight path. This may be shown during power-off landings made in conjunction with other tests.

(c) The airplane must have adequate directional control during taxiing. This may be shown during taxiing prior to takeoffs made in conjunction with other tests.

§ 25.235 Taxiing condition.

The shock absorbing mechanism may not damage the structure of the airplane when the airplane is taxied on the roughest ground that may reasonably be expected in normal operation.

[§ 25.237 Wind velocities.

[(a) For landplanes and amphibians, a 90-degree cross component of wind velocity, demonstrated to be safe for takeoff and landing, must be established for dry runways and must be at least 20 knots or 0.2 V_{S_0}, whichever is greater, except that it need not exceed 25 knots.

[(b) For seaplanes and amphibians, the following applies:

[(1) A 90-degree cross component of wind velocity, up to which takeoff and landing is safe under all water conditions that may reasonably be expected in normal operation, must be established and must be at least 20 knots or 0.2 V_{S_0}, whichever is greater, except that it need not exceed 25 knots.

[(2) A wind velocity, for which taxiing is safe in any direction under all water conditions that may reasonably be expected in normal operation, must be established and must be at least 20 knots or 0.2 V_{S_0}, whichever is greater, except that it need not exceed 25 knots.]

§ 25.239 Spray characteristics, control, and stability on water.

(a) For seaplanes and amphibians, during takeoff, taxiing, and landing, and in the conditions set forth in paragraph (b) of this section, there may be no—

(1) Spray characteristics that would impair the pilot's view, cause damage, or result in the taking in of an undue quantity of water;

(2) Dangerously uncontrollable porpoising, bounding, or swinging tendency; or

(3) Immersion of auxiliary floats or sponsons, wing tips, propeller blades, or other parts not designed to withstand the resulting water loads.

(b) Compliance with the requirements of paragraph (a) of this section must be shown—

(1) In water conditions, from smooth to the most adverse condition established in accordance with § 25.231;

(2) In wind and cross-wind velocities, water currents, and associated waves and swells that may reasonably be expected in operation on water;

(3) At speeds that may reasonably be expected in operation on water;

(4) With sudden failure of the critical engine at any time while on water; and

(5) At each weight and center of gravity position, relevant to each operating condition, within the range of loading conditions for which certification is requested.

(c) In the water conditions of paragraph (b) of this section, and in the corresponding wind conditions, the seaplane or amphibian must be able to drift for five minutes with engines inoperative, aided, if necessary, by a sea anchor.

MISCELLANEOUS FLIGHT REQUIREMENTS

§ 25.251 Vibration and buffeting.

(a) The airplane must be designed to withstand any vibration and buffeting that might occur in any likely operating condition. This must be shown by calculations, resonance tests, or other tests found necessary by the Administrator.

(b) Each part of the airplane must be shown in flight to be free from excessive vibration, under any appropriate speed and power conditions up to at least the minimum value of V_D allowed in § 25.335. The maximum speeds shown must be used in establishing the operating limitations of the airplane in accordance with § 25.1505. In addition, it must be shown by analysis or tests, that the airplane is free from such vibration that would prevent safe flight under the conditions in § 25.629(d).

(c) Except as provided in paragraph (d), there may be no buffeting condition, in normal flight, including configuration changes during cruise, severe enough to interfere with the control of the airplane, to cause excessive fatigue to the crew, or to cause structural damage. Stall warning buffeting within these limits is allowable.

(d) There may be no perceptible buffeting condition in the cruise configuration in straight flight at any speed up to V_{MO}/M_{MO}, except that stall warning buffeting is allowable.

(e) With the airplane in the cruise configuration, the positive maneuvering load factors at which the onset of perceptible buffeting occurs must be determined for the ranges of airspeed or Mach Number, weight, and altitude for which the airplane is to be certificated. The envelopes of load factor, speed, altitude, and weight must provide a sufficient range of speeds and load factors for normal operations. Probable inadvertent excursions beyond the boundaries of the buffet onset envelopes may not result in unsafe conditions.

§ 25.253 High-speed characteristics.

(a) *Speed increase and recovery characteristics.* The following speed increase and recovery characteristics must be met:

(1) Operating conditions and characteristics likely to cause inadvertent speed increases (including upsets in pitch and roll) must be simulated with the airplane trimmed at any likely cruise speed up to V_{MO}/M_{MO}. These conditions and characteristics include gust upsets, inadvertent control movements, low stick force gradient in relation to control friction, passenger movement, leveling off from climb, and descent from Mach to airspeed limit altitudes.

(2) Allowing for pilot reaction time after effective inherent or artificial speed warning occurs, it must be shown that the airplane can be recovered to a normal altitude and its speed reduced to V_{MO}/M_{MO}, without—

(i) Exceptional piloting strength or skill;

(ii) Exceeding V_D/M_D, V_{DF}/M_{DF}, or the structural limitations; and

[(iii) Buffeting that would impair the pilot's ability to read the instruments or control the airplane for recovery.]

(3) There may be no control reversal about any axis at any speed up to V_{DF}/M_{DF}. Any reversal of elevator control force or tendency of the airplane to pitch, roll, or yaw must be mild and readily controllable, using normal piloting techniques.

(b) *Maximum speed for stability characteristics, V_{FC}/M_{FC}.* V_{FC}/M_C is the maximum speed at which the requirements of §§ 25.147 (e), 25.175(b)(1), 25.177, and 25.181 must be met with flaps and landing gear retracted. It may not be less than a speed midway between V_{MO}/M_{MO} and V_{DF}/M_{DF}, except that, for altitudes where Mach number is the limiting factor, M_{FC} need not exceed the Mach number at which effective speed warning occurs.

§ 25.255 Out-of-trim characteristics.

(a) From an initial condition with the airplane trimmed at cruise speeds up to V_{MO}/M_{MO}, the airplane must have satisfactory maneuvering stability and controllability with the degree of out-of-trim in both the airplane nose-up and nose-down directions, which results from the greater of—

(1) A three-second movement of the longitudinal trim system at its normal rate for the particular flight condition with no aerodynamic load (or an equivalent degree of trim for airplanes that do not have a power-operated trim system), except as limited by stops in the trim system, including those required by § 25.655(b) for adjustable stabilizers; or

[(2) The maximum mistrim that can be sustained by the autopilot while maintaining level flight in the high speed cruising condition.

[(b) In the out-of-trim condition specified in paragraph (a) of this section, when the normal acceleration is varied from +1 g to the positive and negative values specified in paragraph (c) of this section—

[(1) The stick force vs. g curve must have a positive slope at any speed up to and including V_{FC}/M_{FC}; and

[(2) At speeds between V_{FC}/M_{FC} and V_{DF}/M_{DF} the direction of the primary longitudinal control force may not reverse.

[(c) Except as provided in paragraphs (d) and (e) of this section, compliance with the provisions of paragraph (a) of this section must be demonstrated in flight over the acceleration range—

[(1) −1 g to +2.5 g; or

[(2) 0 g to 2.0 g, and extrapolating by an acceptable method to −1 g and +2.5 g.

[(d) If the procedure set forth in paragraph (c)(2) of this section is used to demonstrate compliance and marginal conditions exist during flight test with regard to reversal of primary longitudinal control force, flight tests must be accomplished from the normal acceleration at which a marginal condition is found to exist to the applicable limit specified in paragraph (b)(1) of this section.

[(e) During flight tests required by paragraph (a) of this section, the limit maneuvering load factors prescribed in §§ 25.333(b) and 25.337, and the maneuvering load factors associated with probable inadvertent excursions beyond the boundaries of the buffet onset envelopes determined under § 25.251(e), need not be exceeded. In addition, the entry speeds for flight test demonstrations at normal acceleration values less than 1 g must be limited to the extent necessary to accomplish a recovery without exceeding V_{DF}/M_{DF}.

[(f) In the out-of-trim condition specified in paragraph (a) of this section, it must be possible from an overspeed condition at V_{DF}/M_{DF} to produce at least 1.5 g for recovery by applying not more than 125 pounds of longitudinal control force using either the primary longitudinal control alone or the primary longitudinal control and the longitudinal trim system. If the longitudinal trim is used to assist in producing the required load factor, it must be shown at V_{DF}/M_{DF} that the longitudinal trim can be actuated in the airplane nose-up direction with the primary surface loaded to correspond to the least of the following airplane nose-up control forces:

[(1) The maximum control forces expected in service as specified in §§ 25.301 and 25.397.

[(2) The control force required to produce 1.5 g.

[(3) The control force corresponding to buffeting or other phenomena of such intensity that it is a strong deterrent to further application of primary longitudinal control force.]

Subpart C—Structure

GENERAL

§ 25.301 Loads.

(a) Strength requirements are specified in terms of limit loads (the maximum loads to be expected in service) and ultimate loads (limit loads multiplied by prescribed factors of safety). Unless otherwise provided, prescribed loads are limit loads.

(b) Unless otherwise provided, the specified air, ground, and water loads must be placed in equilibrium with inertia forces, considering each item of mass in the airplane. These loads must be distributed to conservatively approximate or closely represent actual conditions. Methods used to determine load intensities and distribution must be validated by flight load measurement unless the methods used for determining those loading conditions are shown to be reliable.

(c) If deflections under load would significantly change the distribution of external or internal loads, this redistribution must be taken into account.

§ 25.303 Factor of safety.

Unless otherwise specified, a factor of safety of 1.5 must be applied to the prescribed limit load which are considered external loads on the structure. When a loading condition is prescribed in terms of ultimate loads, a factor of safety need not be applied unless otherwise specified.

§ 25.305 Strength and deformation.

(a) The structure must be able to support limit loads without detrimental permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.

(b) The structure must be able to support ultimate loads without failure for at least 3 seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the 3-second limit does not apply. Static tests conducted to ultimate load must include the ultimate deflections and ultimate deformation induced by the loading. When analytical methods are used to show compliance with the ultimate load strength requirements, it must be shown that—

(1) The effects of deformation are not significant;

(2) The deformations involved are fully accounted for in the analysis; or

(3) The methods and assumptions used are sufficient to cover the effects of these deformations.

(c) Where structural flexibility is such that any rate of load application likely to occur in the operating conditions might produce transient stresses appreciably higher than those corresponding to static loads, the effects of this rate of application must be considered.

[(d) The dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. The continuous gust design criteria of Appendix G of this Part must be used to establish the dynamic response unless more rational criteria are shown.

[§ 25.307 Proof of structure.

[(a) Compliance with the strength and deformation requirements of this subpart must be shown for each critical loading condition. Structural analysis may be used only if the structure conforms to those for which experience has shown this method to be reliable. The Administrator may require ultimate load tests in cases where limit load tests may be inadequate.]

(b) Compliance with the fatigue evaluation requirements of §§ 25.571 and 25.573 must be shown.

(c) Certain parts of the structure must be tested as specified in § 25.601.

(d) When static or dynamic tests are used to show compliance with the requirements of § 25.305(b) for flight structures, appropriate material correction factors must be applied to the test results, unless the structure, or part thereof, being tested has features such that a number of elements contribute to the total strength of the structure and the failure of one element results in the redistribution of the load through alternate load paths.

FLIGHT LOADS

§ 25.321 General.

(a) Flight load factors represent the ratio of the aerodynamic force component (acting normal to the assumed longitudinal axis of the airplane) to the weight of the airplane. A positive load factor is one in which the aerodynamic force acts upward with respect to the airplane.

(b) Considering compressibility effects at each speed, compliance with the flight load requirements of this subpart must be shown—

(1) At each critical altitude within the range of altitudes selected by the applicant;

(2) At each weight from the design minimum weight to the design maximum weight appropriate to each particular flight load condition; and

(3) For each required altitude and weight, for any practicable distribution of disposable load within the operating limitations recorded in the Airplane Flight Manual.

FLIGHT MANEUVER AND GUST CONDITIONS

§ 25.331 General.

(a) *Procedure.* The analysis of symmetrical flight must include at least the conditions specified in paragraphs (b) through (d) of this section. The following procedure must be used:

(1) Enough points on the maneuvering and gust envelopes must be investigated to ensure that the maximum load for each part of the airplane structure is obtained. A conservative combined envelope may be used.

(2) The significant forces acting on the airplane must be placed in equilibrium in a rational or conservative manner. The linear inertia forces must be considered in equilibrium with thrust and all aerodynamic loads, while the angular (pitching) inertia forces must be considered in equilibrium with thrust and all aerodynamic moments, including moments due to loads on components such as tail surfaces and nacelles. Critical thrust values in the range from zero to maximum continuous thrust must be considered.

(3) Where sudden displacement of a control is specified, the assumed rate of control surface displacement may not be less than the rate that could be applied by the pilot through the control system.

(4) In determining elevator angles and chordwise load distribution (in the maneuvering conditions of paragraphs (b) and (c) of this section) in turns and pullups, the effect of corresponding pitching velocities must be taken into account. [The in-trim and out-of-trim flight conditions specified in § 25.255 must be considered.]

(b) *Maneuvering balanced conditions.* Assuming the airplane to be in equilibrium with zero pitching acceleration, the maneuvering conditions A through I on the maneuvering envelope in § 25.333(b) must be investigated.

(c) *Maneuvering pitching conditions.* The following conditions involving pitching acceleration must be investigated:

[(1) *Maximum elevator displacement at V_A.* The airplane is assumed to be flying in steady level flight (point A_1, § 25.333(b)) and, except as limited by pilot effort in accordance with § 25.397(b), the pitching control is suddenly moved to obtain extreme positive pitching acceleration (nose up). The dynamic response or, at the option of the applicant, the transient rigid body response of the airplane, must be taken into account in determining the tail load. Airplane loads which occur subsequent to the normal acceleration at the center of gravity exceeding the maximum positive limit maneuvering load factor, n, need not be considered.

[(2) *Special control displacement.* A checked maneuver, based on a rational pitching control motion vs. time profile, must be established in which the design limit load factor specified in § 25.337 will not be exceeded. Unless lesser values cannot be exceeded, the airplane response must result in pitching accelerations not less than the following:

[(i) A positive pitching acceleration (nose up) is assumed to be reached concurrently with the airplane load factor of 1.0 (points A to D, § 25.333(b)). The positive acceleration must be equal to at least

$$\frac{39n}{V}\ (n-1.5),\ (\text{Radians/sec.}^2)$$

where—

n is the positive load factor at the speed under consideration; and

V is the airplane equivalent speed in knots.

[(ii) A negative pitching acceleration (nose down) is assumed to be reached concurrently with the positive maneuvering load factor (points A to D, § 25.333(b)). This negative pitching action must be equal to at least

$$\frac{-26n}{V}\ (n-1.5),\ (\text{Radians/sec.}^2)$$

where—

n is the positive load factor at the speed under consideration; and V is the airplane equivalent speed in knots.

[(3) [Reserved.]]

(d) *Gust conditions.* The gust conditions B′ through J′, § 25.333(c), must be investigated. The following provisions apply:

(1) The air load increment due to a specified gust must be added to the initial balancing tail load corresponding to steady level flight.

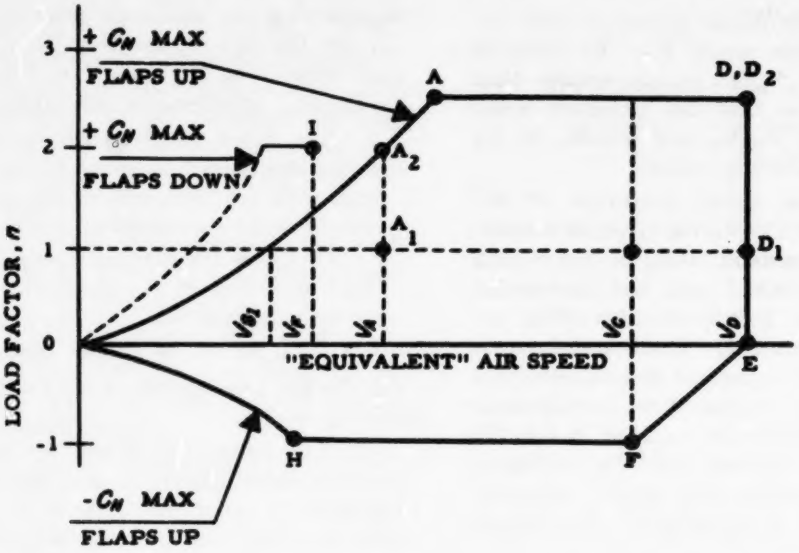
(2) The alleviating effect of wing downwash and of the airplane's motion in response to the gust may be included in computing the tail gust load increment.

(3) Instead of a rational investigation of the airplane response, the gust alleviation factor K_g may be applied to the specified gust intensity for the horizontal tail.

§ 25.333 Flight envelope.

(a) *General.* The strength requirements must be met at each combination of airspeed and load factor on and within the boundaries of the representative maneuvering and gust envelopes (V–n diagrams) of paragraphs (b) and (c) of this section. These envelopes must also be used in determining the airplane structural operating limitations as specified in § 25.1501.

(b) *Maneuvering envelope.*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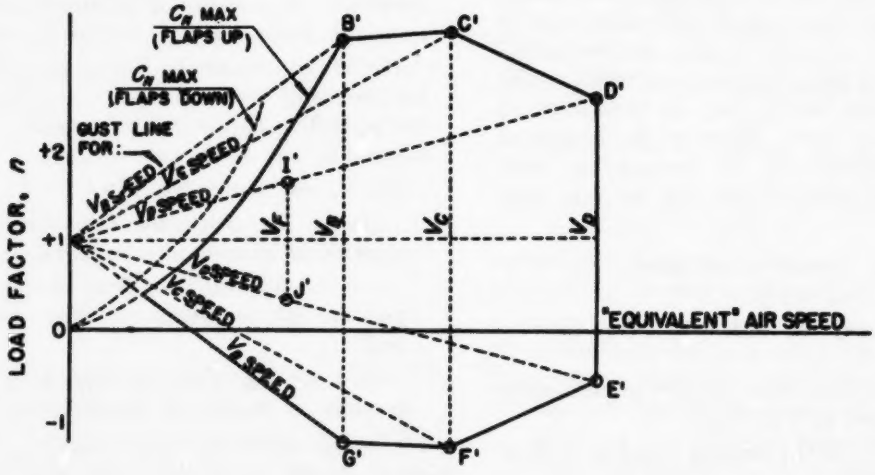
(c) *Gust envelope.*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V_C
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V_C SPEED
V_D SPEED
"EQUIVALENT" AIR SPEED
E'
G'
F'

§ 25.335 Design airspeeds.

The selected design airspeeds are equivalent airspeeds (EAS). Estimated values of V_{S_0} and V_{S_1} must be conservative.

(a) *Design cruising speed*, V_C. For V_C, the following apply:

(1) The minimum value of V_C must be sufficiently greater than V_B to provide for inadvertent speed increases likely to occur as a result of severe atmospheric turbulence.

(2) In the absence of a rational investigation substantiating the use of other values, V_C may not be less than V_B+43 knots. However, it need not exceed the maximum speed in level flight at maximum continuous power for the corresponding altitude.

(3) At altitudes where V_D is limited by Mach number, V_C may be limited to a selected Mach number.

(b) *Design dive speed, V_D.* V_D must be selected so that V_C/M_C is not greater than 0.8 V_D/M_D, or so that the minimum speed margin between V_C/M_C *and* V_D/M_D is the greater of the following values:

(1) From an initial condition of stabilized flight at V_C/M_C, the airplane is upset, flown for 20 seconds along a flight path 7.5° below the initial path, and then pulled up at a load factor of 1.5g (0.5g acceleration increment). The speed increase occurring in this maneuver may be calculated if reliable or conservative aerodynamic data issued. Power as specified in § 25.175 (b)(1)(iv) is assumed until the pullup is initiated, at which time power reduction and the use of pilot controlled drag devices may be assumed;

(2) The minimum speed margin must be enough to provide for atmospheric variations (such as horizontal gusts, and penetration of jet streams and cold fronts) and for instrument errors and airframe production variations. These factors may be considered on a probability basis. However, the margin at altitude where M_C is limited by compressibility effects may not be less than 0.05M.

(c) Design maneuvering speed, V_A. For V_A, the following apply:

(1) V_A may not be less than $V_{S_1} \sqrt{n}$ where—

(i) n is the limit positive maneuvering load factor at V_C; and

(ii) V_{S_1} is the stalling speed with flaps retracted.

(2) V_A and V_S must be evaluated at the design weight and altitude under consideration.

(3) V_A need not be more than V_C or the speed at which the positive $C_{N\ max}$ curve intersects the positive maneuver load factor line, whichever is less.

(d) *Design speed for maximum gust intensity, V_B.* For V_B, the following apply:

(1) V_B may not be less than the speed determined by the intersection of the line representing the maximum position lift $C_{N\ max}$ and the line representing the rough air gust velocity on the gust V-n diagram, or $(\sqrt{n_g})\ V_{S_1}$, whichever is less, where—

(i) n_g is the positive airplane gust load factor due to gust, at speed V_C (in accordance with § 25.341), and at the particular weight under consideration; and

(ii) V_{S_1} is the stalling speed with the flaps retracted at the particular weight under consideration.

(2) V_B need not be greater than V_C.

(e) *Design flap speeds, V_F.* For V_F, the following apply:

(1) The design flap speed for each flap position (established in accordance with § 25.697(a)) must be sufficiently greater than the operating speed recommended for the corresponding stage of flight (including balked landings) to allow for probable variations in control of airspeed and for transition from one flap position to another.

(2) If an automatic flap positioning or load limiting device is used, the speeds and corresponding flap positions programmed or allowed by the device may be used.

(3) V_F may not be less than—

(i) 1.6 V_{S_1} with the flaps in takeoff position at maximum takeoff weight;

(ii) 1.8 V_{S_1} with the flaps in approach position at maximum landing weight; and

(iii) 1.8 V_{S_0} with the flaps in landing position at maximum landing weight.

(f) *Design drag device speeds, V_{DD}.* The selected design speed for each drag device must be sufficiently greater than the speed recommended for the operation of the device to allow for probable variations in speed control. For drag devices intended for use in high speed descents, V_{DD} may not be less than V_D. When an automatic drag device positioning or load limiting means is used, the speeds and corresponding drag device positions programmed or allowed by the automatic means must be used for design.

§ 25.337 Limit maneuvering load factors.

(a) Except where limited by maximum (static) lift coefficients, the airplane is assumed to be subjected to symmetrical maneuvers resulting in the limit maneuvering load factors prescribed in this section. Pitching velocities appropriate to the corresponding pull-up and steady turn maneuvers must be taken into account.

(b) The positive limit maneuvering load factor "n" for any speed up to V_D may not be less than $2.1+\left(\frac{24{,}000}{W+10{,}000}\right)$ except that "n" may not be less than 2.5 and need not be greater than 3.8—where "W" is the design maximum takeoff weight.

(c) The negative limit maneuvering load factor—

(1) May not be less than −1.0 at speeds up to V_C; and

(2) Must vary linearly with speed from the value at V_C to zero at V_D.

(d) Maneuvering load factors lower than those specified in this section may be used if the airplane has design features that make it impossible to exceed these values in flight.

§ 25.341 Gust loads.

(a) The airplane is assumed to be subjected to symmetrical vertical gusts in level flight. The resulting limit load factors must correspond to the conditions determined as follows:

(1) Positive (up) and negative (down) rough air gusts of 66 fps at V_B must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 66 fps at 20,000 feet to 38 fps at 50,000 feet.

(2) Positive and negative gusts of 50 fps at V_C must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 50 fps at 20,000 feet to 25 fps at 50,000 feet.

(3) Positive and negative gusts of 25 fps at V_D must be considered at altitudes between sea level and 20,000 feet. The gust velocity may be reduced linearly from 25 fps at 20,000 feet to 12.5 fps at 50,000 feet.

(b) The following assumptions must be made:

(1) The shape of the gust is

$$U=\frac{U_{de}}{2}\left(1-\cos\right)\frac{2\pi s}{25\bar{C}}$$

where—

s=distance penetrated into gust (ft);

$\bar{C}$=mean geometric chord of wing (ft); and

U_{de}=derived gust velocity referred to in paragraph (a) (fps).

(2) Gust load factors vary linearly between the specified conditions B′ through G′, as shown on the gust envelope in § 25.333(c).

(c) In the absence of a more rational analysis, the gust load factors must be computed as follows:

$$n=1+\frac{K_g U_{de} Va}{498\ (W/S)}$$

where—

$K_g=\frac{0.88\mu_g}{5.3+\mu_g}$=gust alleviation factor;

$\mu_g=\frac{2\ (W/S)}{\rho\bar{C}ag}$=airplane mass ratio;

U_{de}= derived gust velocities referred to in paragraph (a) (fps);

ρ=density of air (slugs/cu.ft.);

W/S=wing loading (psf);

$\bar{C}$=mean geometric chord (ft.);

g=acceleration due to gravity (ft/sec.^{2});

V=airplane equivalent speed (knots); and

a=slope of the airplane normal force coefficient curve C_{N_A} per radian if the gust loads are applied to the wings and horizontal tail surfaces simultaneously by a rational method. The wing lift curve slope C_L per radian may be used when the gust load is applied to the wings only and the horizontal tail gust loads are treated as a separate condition.

§ 25.343 Design fuel and oil loads.

(a) The disposable load combinations must include each fuel and oil load in the range from zero fuel and oil to the selected maximum fuel and oil load. A structural reserve fuel condition, not exceeding 45 minutes of fuel under the operating conditions in § 25.1001(h) and (i), as applicable, may be selected.

(b) If a structural reserve fuel condition is selected, it must be used as the minimum fuel weight condition for showing compliance with the flight load requirements as prescribed in this subpart. In addition—

(1) The structure must be designed for a condition of zero fuel and oil in the wing at limit loads corresponding to—

(i) A maneuvering load factor of +2.25; and

(ii) Gust intensities equal to 85 percent of the values prescribed in § 25.341; and

(2) Fatigue evaluation of the structure must account for any increase in operating stresses resulting from the design condition of subparagraph (b)(1) of this paragraph; and

(3) The flutter, deformation, and vibration requirements must also be met with zero fuel.

§ 25.345 High lift devices.

(a) If flaps are to be used during takeoff, approach, or landing, at the design flap speeds established for these stages of flight under § 25.335(e) and with the flaps in the corresponding positions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by—

(1) Maneuvering to a positive limit load factor of 2.0; and

(2) Positive and negative 25 fps derived gusts acting normal to the flight path in level flight.

(b) The airplane must be designed for the conditions prescribed in paragraph (a) of this section, except that the airplane load factor need not exceed 1.0, taking into account, as separate conditions, the effects of—

(1) Propeller slipstream corresponding to maximum continuous power at the design flap speeds V_F, and with takeoff power at not less than 1.4 times the stalling speed for the particular flap position and associated maximum weight; and

(2) A head-on gust of 25 feet per second velocity (EAS).

[(c) If flaps or similar high lift devices are to be used in en route conditions, and with flaps in the appropriate position at speeds up to the flap design speed chosen for these conditions, the airplane is assumed to be subjected to symmetrical maneuvers and gusts within the range determined by—**]**

(1) Maneuvering to a positive limit load factor of 2.5; and

(2) Positive and negative derived gusts as prescribed in § 25.341 acting normal to the flight path in level flight.

[(d) The airplane must be designed for landing at the maximum takeoff weight with a maneuvering load factor of 1.5g and the flaps and similar high lift devices in the landing configuration.**]**

§ 25.349 Rolling conditions.

The airplane must be designed for rolling loads resulting from the conditions specified in paragraphs (a) and (b) of this section. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner, considering the principal masses furnishing the reacting inertia forces.

(a) *Maneuvering.* The following conditions, speeds, and aileron deflections (except as the deflections may be limited by pilot effort) must be considered in combination with an airplane load factor of zero and of two-thirds of the positive maneuvering factor used in design. In determining the required aileron deflections, the torsional flexibility of the wing must be considered in accordance with § 25.301(b):

(1) Conditions corresponding to steady rolling velocities must be investigated. In addition, conditions corresponding to maximum angular acceleration must be investigated for airplanes with engines or other weight concentrations outboard of the fuselage. For the angular acceleration conditions, zero rolling velocity may be assumed in the absence of a rational time history investigation of the maneuver.

(2) At V_A, a sudden deflection of the aileron to the stop is assumed.

(3) At V_C, the aileron deflection must be that required to produce a rate of roll not less than that obtained in subparagraph (2) of this paragraph.

(4) At V_D, the aileron deflection must be that required to produce a rate of roll not less than one-third of that in subparagraph (2) of this paragraph.

(b) *Unsymmetrical gusts.* The condition of unsymmetrical gusts must be considered by modifying the symmetrical flight conditions B′ or C′ (in § 25.333(c)) whichever produces the critical load. It is assumed that 100 percent of the wing air load acts on one side of the airplane and 80 percent acts on the other side.

§ 25.351 Yawing conditions.

The airplane must be designed for loads resulting from the conditions specified in paragraphs (a) and (b) of this section. Unbalanced aerodynamic moments about the center of gravity must be reacted in a rational or conservative manner considering the principal masses furnishing the reacting inertia forces:

(a) *Maneuvering.* At speeds from V_{MC} to [V_D], the following maneuvers must be considered. In computing the tail loads, the yawing velocity may be assumed to be zero:

(1) With the airplane in unaccelerated flight at zero yaw, it is assumed that the rudder control is suddenly displaced to the maximum deflection, as limited by the control surface stops, or by a 300 pound rudder pedal force, whichever is less.

(2) With the rudder deflected as specified in subparagraph (1) of this paragraph, it is assumed that the airplane yaws to the resulting sideslip angle.

(3) With the airplane yawed to the static sideslip angle corresponding to the rudder deflection specified in subparagraph (1) of this paragraph, it is assumed that the rudder is returned to neutral.

(b) *Lateral gusts.* The airplane is assumed to encounter derived gusts normal to the plane of symmetry while in unaccelerated flight. The derived gusts and airplane speeds corresponding to conditions B′ through J′ (in § 25.333(c)) (as determined by §§ 25.341 and 25.345(a)(2) or 25.345(c)(2)) must be investigated. The shape of the gust must be as specified in § 25.341. In the absence of a rational investigation of the airplane's response to a gust, the gust loading on the vertical tail surfaces must be computed as follows:

$$L_t = \frac{K_{g_t} U_{de} V_{a_t} S_t}{498}$$

where—

L_t = vertical tail load (lbs.);

$K_{g_t} = \frac{0.88\mu_{g_t}}{5.3+\mu_{g_t}}$ = gust alleviation factor;

$\mu_{g_t} = \frac{2W}{\rho \overline{C}_t g a_t S_t}\left(\frac{K}{l_t}\right)^2$ = lateral mass ratio;

U_{de} = derived gust velocity (fps);

ρ = air density (slugs/cu. ft.);

W = airplane weight (lbs.);

S_t = area of vertical tail (ft.^{2});

$\overline{C}_t$ = mean geometric chord of vertical surface (ft.);

a_t = lift curve slope of vertical tail (per radian);

K = radius of gyration in yaw (ft.);

l_t = distance from airplane c.g. to lift center of vertical surface (ft.);

g = acceleration due to gravity (ft./sec.^{2}); and

V = airplane equivalent speed (knots).

SUPPLEMENTARY CONDITIONS

§ 25.361 Engine torque.

(a) Each engine mount and its supporting structures must be designed for engine torque effects combined with—

(1) [A] limit engine torque corresponding to takeoff power and propeller speed acting simultaneously with 75 percent of the limit loads from flight condition A of § 25.333(b);

(2) [A limit engine torque as specified in § 25.361(c)] acting simultaneously with the limit loads from flight condition A of § 25.333(b); and

(3) For turbopropeller installations, in addition to the conditions specified in subparagraphs (1) and (2) of this paragraph, [a] limit engine torque corresponding to takeoff power and propeller speed, multiplied by a factor accounting for propeller control system malfunction, including quick feather-

ing, acting simultaneously with 1g level flight loads. In the absence of a rational analysis, a factor of 1.6 must be used.

(b) For turbine engine installations, the engine mounts and supporting structure must be designed to withstand each of the following:

(1) A limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure (such as compressor jamming).

(2) A limit engine torque load imposed by the maximum acceleration of the engine.

(c) The limit engine torque to be considered under paragraph (a)(2) of this section must be obtained by multiplying the mean torque for maximum continuous power by a factor of—

(1) 1.25 for turbopropeller installations;

(2) 1.33 for reciprocating engines with five or more cylinders; or

(3) Two, three, or four, for engines with four, three, or two cylinders, respectively.

§ 25.363 Side load on engine mount.

(a) Each engine mount and its supporting structure must be designed for a limit load factor in a lateral direction, for the side load on the engine mount, at least equal to the maximum load factor obtained in the yawing conditions but not less than—

(1) 1.33; or

(2) One-third of the limit load factor for flight condition A as prescribed in § 25.333 (b).

(b) The side load prescribed in paragraph (a) of this section may be assumed to be independent of other flight conditions.

§ 25.365 Pressurized cabin loads.

For each pressurized compartment for occupants, the following apply:

(a) The airplane structure must be strong enough to withstand the flight loads combined with pressure differential loads from zero up to the maximum relief valve setting.

(b) The external pressure distribution in flight, and stress concentrations and fatigue effects must be accounted for.

(c) If landings may be made with the cabin pressurized, landing loads must be combined with pressure differential loads from zero up to the maximum allowed during landing.

(d) The airplane structure must be strong enough to withstand the pressure differential loads corresponding to the maximum relief valve setting multiplied by a factor of 1.33, omitting other loads.

[(e) Partitions, bulkheads, and floors in pressurized cabins must be designed to withstand the effects of a sudden release of pressure through an opening in any compartment at any approved operating altitude resulting from any of the following conditions (to be considered as ultimate conditions):

[(1) The penetration of the cabin by a portion of an engine following an engine disintegration;

[(2) An opening in any passenger or cargo compartment given by the equation—

$$H_o - PA_s$$

where,

H_o = maximum opening in square feet, not to exceed 20 square feet.

$$P = \frac{A_s}{6240} + .024$$

A_s = maximum cross sectional area of pressurized shell normal to the longitudinal axis, in square feet; and

[(3) The maximum opening caused by airplane or equipment failures not shown to be extremely improbable.]

(f) In determining the probability of failure or penetration and probable size of openings, the fail-safe features of the design may be considered if possible improper operation of closure devices and inadvertent door openings are also considered. The pressure relief provided by intercompartment venting may also be considered.

(g) Reasonable design precautions must be taken to minimize the probability of parts becoming detached and injuring occupants while in their seats.

§ 25.367 Unsymmetrical loads due to engine failure.

(a) The airplane must be designed for the unsymmetrical loads resulting from the failure of the critical engine. Turbopropeller airplanes must be designed for the following conditions in combination with a single malfunction of the propeller drag limiting system, considering the probable pilot corrective action on the flight controls:

(1) At speeds between V_{MC} and V_D, the loads resulting from power failure because of fuel flow interruption are considered to be limit loads.

(2) At speeds between V_{MC} and V_C, the loads resulting from the disconnection of the engine compressor from the turbine or from loss of the turbine blades are considered to be ultimate loads.

(3) The time history of the thrust decay and drag build-up occurring as a result of the prescribed engine failures must be substantiated by test or other data applicable to the particular engine-propeller combination.

(4) The timing and magnitude of the probable pilot corrective action must be conservatively estimated, considering the characteristics of the particular engine-propeller-airplane combination.

(b) Pilot corrective action may be assumed to be initiated at the time maximum yawing velocity is reached, but not earlier than two seconds after the engine failure. The magnitude of the corrective action may be based on the control forces specified in § 25.397(b) except that lower forces may be assumed where it is shown by analysis or test that these forces can control the yaw and roll resulting from the prescribed engine failure conditions.

§ 25.371 Gyroscopic loads.

The structure supporting the engines must be designed for gyroscopic loads associated with the conditions specified in §§ 25.331, 25.349, and 25.351, with the engines at maximum continuous r.p.m.

§ 25.373 Speed control devices.

If speed control devices (such as spoilers and drag flaps) are installed for use in en route conditions—

(a) The airplane must be designed for the symmetrical maneuvers and gusts prescribed in §§ 25.333, 25.337, and 25.341, and the yawing maneuvers and lateral gusts in § 25.351, with the device extended at speeds up to the placard device extended speed; and

(b) If the device has automatic operating or load limiting features, the airplane must be designed for the maneuver and gust conditions prescribed in paragraph (a) of this section, at the speeds and corresponding device positions that the mechanism allows.

CONTROL SURFACE AND SYSTEM LOADS

§ 25.391 Control surface loads: general.

The control surfaces must be designed for the limit loads resulting from the flight conditions in §§ 25.331, 25.349, and 25.351 and the ground gust conditions in § 25.415, considering the requirements for—

(a) Loads parallel to hinge line, in § 25.393;

(b) Pilot effort effects, in § 25.397;

(c) Trim tab effects, in § 25.407;

(d) Unsymmetrical loads, in § 25.427; and

(e) Outboard fins, in § 25.445.

§ 25.393 Loads parallel to hinge line.

(a) Control surfaces and supporting hinge brackets must be designed for inertia loads acting parallel to the hinge line.

(b) In the absence of more rational data, the inertia loads may be assumed to be equal to KW, where—

(1) $K = 24$ for vertical surfaces;

(2) $K = 12$ for horizontal surfaces; and

(3) W = weight of the movable surfaces.

§ 25.395 Control system.

(a) Longitudinal, lateral, directional and drag control systems and their supporting structures must be designed for loads corresponding to 125 percent of the computed hinge moments of the movable control surface in the conditions prescribed in § 25.391.

(b) The system limit loads, except the loads resulting from ground gusts, need not exceed the loads that can be produced by the pilot (or pilots) and by automatic or power devices operating the controls. The loads must be great enough to provide a rugged system for service use.

§ 25.397 Control system loads.

(a) *General.* The maximum and minimum pilot forces, specified in paragraph (c) of this section, are assumed to act at the appropriate control grips or pads (in a manner simulating flight conditions) and to be reacted at the attachment of the control system to the control surface horn.

(b) *Pilot effort effects.* In the control surface flight loading condition, the air loads on movable surfaces and the corresponding deflections need not exceed those that would result in flight from the application of any pilot force within the ranges specified in paragraph (c) of this section. Two-thirds of the maximum values specified for the aileron and elevator may be used if control surface hinge moments are based on reliable data. In applying this criterion, the effects of servo mechanisms, tabs, and automatic pilot systems, must be considered.

[(c) *Limit pilot forces and torques.* The limit pilot forces and torques are as follows:

Control	Maximum forces or torques	Minimum forces or torques
Aileron:		
Stick	100 lbs.	40 lbs.
Wheel*	80 D in.-lbs.**	40 D in.-lbs.
Elevator:		
Stick	250 lbs.	100 lbs.
Wheel (symmetrical)	300 lbs.	100 lbs.
Wheel (unsymmetrical)[1]		100 lbs.
Rudder	300 lbs.	130 lbs.]

*The critical parts of the aileron control system must be designed for a single tangential force with a limit value equal to 1.25 times the couple force determined from these criteria.

**D=wheel diameter (inches).

[[1] The unsymmetrical forces most applied at one of the normal handgrip points on the periphery of the control wheel.]

§ 25.399 Dual control system.

(a) Each dual control system must be designed for the pilots operating in opposition, using individual pilot forces not less than—

(1) 0.75 times those obtained under § 25.395; or

(2) The minimum forces specified in § 25.397(c).

(b) The control system must be designed for pilot forces applied in the same direction, using individual pilot forces not less than 0.75 times those obtained under § 25.395.

§ 25.405 Secondary control system.

Secondary controls, such as wheel brake, spoiler, and tab controls, must be designed for the maximum forces that a pilot is likely to apply to those controls. The following values may be used:

PILOT CONTROL FORCE LIMITS (SECONDARY CONTROLS)

Control	Limit pilot forces
Miscellaneous: *Crank, wheel, or lever.	$\left(\frac{1+R}{3}\right)\times 50$ lbs., but not less than 50 lbs. nor more than 150 lbs. (R= radius). (Applicable to any angle within 20° of plane of control).
Twist	133 in.-lbs.
Push-pull	To be chosen by applicant.

*Limited to flap, tab, stabilizer, spoiler, and landing gear operation controls.

§ 25.407 Trim tab effects.

The effects of trim tabs on the control surface design conditions must be accounted for only where the surface loads are limited by maximum pilot effort. In these cases, the tabs are considered to be deflected in the direction that would assist the pilot, and the deflections are—

(a) For elevator trim tabs, those required to trim the airplane at any point within the positive portion of the pertinent flight envelope in § 25.333(b), except as limited by the stops; and

(b) For aileron and rudder trim tabs, those required to trim the airplane in the critical unsymmetrical power and loading conditions, with appropriate allowance for rigging tolerances.

§ 25.409 Tabs.

(a) *Trim tabs.* Trim tabs must be designed to withstand loads arising from all likely combinations of tab setting, primary control position, and airplane speed (obtainable without exceeding the flight load conditions prescribed for the airplane as a whole), when the effect of the tab is opposed by pilot effort forces up to those specified in § 25.397(b).

(b) *Balancing tabs.* Balancing tabs must be designed for deflections consistent with the primary control surface loading conditions.

(c) *Servo tabs.* Servo tabs must be designed for deflections consistent with the primary control surface loading conditions obtainable within the pilot maneuvering effort, considering possible opposition from the trim tabs.

§ 25.415 Ground gust conditions.

(a) The control system must be designed as follows for control surface loads due to ground gusts and taxiing downwind:

(1) The control system between the stops nearest the surfaces and the cockpit controls must be designed for loads corresponding to the limit hinge moments H of subparagraph (2) of this paragraph. These loads need not exceed—

(i) The loads corresponding to the maximum pilot loads in § 25.397(c) for each pilot alone; or

(ii) 0.75 times these maximum loads for each pilot when the pilot forces are applied in the same direction.

(2) The control system stops nearest the surfaces, the control system locks, and the parts of the systems (if any) between these stops and locks and the control surface horns, must be designed for limit hinge moments H obtained from the formula, $H=KcSq$, where—

H=limit hinge moment (ft. lbs.);

c=mean chord of the control surface aft of the hinge line (ft.);

S=area of the control surface aft of the hinge line (sq. ft.);

q=dynamic pressure (p.s.f.) based on a design speed not less than $14.6\sqrt{W/S}+14.6$ (f.p.s.), except that the design speed need not exceed 88 f.p.s.; and

K=limit hinge moment factor for ground gusts derived in paragraph (b) of this section.

(b) The limit hinge moment factor K for ground gusts must be derived as follows:

Surface	K	Position of controls
(a) Aileron	0.75	Control column locked or lashed in mid-position.
(b) Aileron	*±0.50	Ailerons at full throw.
(c) (d) Elevator	*±0.75	(c) Elevator full down. (d) Elevator full up.
(e) (f) Rudder	0.75	(e) Rudder in neutral. (f) Rudder at full throw.

*A positive value of K indicates a moment tending to depress the surface, while a negative value of K indicates a moment tending to raise the surface.

§ 25.427 Unsymmetrical loads.

(a) Horizontal tail surfaces and their supporting structure must be designed for unsymmetrical loads arising from yawing and slipstream effects, in combination with the prescribed flight conditions.

(b) In the absence of more rational data, the following apply:

(1) For airplanes that are conventional in regard to location of propellers, wings, tail surfaces, and fuselage shape—

(i) 100 percent of the maximum loading from the symmetrical flight conditions may be assumed to act on the surface on one side of the plane of symmetry; and

(ii) 80 percent of this loading may be assumed to act on the other side.

(2) For empennage arrangements where the horizontal tail surfaces have appreciable dihedral or are supported by the vertical tail surfaces, the surfaces and supporting structure must be designed for the combined vertical and horizontal surface loads resulting from each prescribed flight load condition considered separately.

§ 25.445 Outboard fins.

(a) If outboard fins are on the horizontal tail surface, the tail surfaces must be designed for the maximum horizontal surface load in combination with the corresponding loads induced on the vertical surfaces by endplate effects. These induced effects need not be combined with other vertical surface loads.

(b) To provide for unsymmetrical loading when outboard fins extend above and below the horizontal surface, the critical vertical surface loading (load per unit area) determined under § 25.391 must also be applied as follows:

(1) 100 percent to the area of the vertical surfaces above (or below) the horizontal surface.

(2) 80 percent to the area below (or above) the horizontal surface.

§ 25.457 Wing flaps.

Wing flaps, their operating mechanisms, and their supporting structures must be designed for critical loads occurring in the conditions prescribed in § 25.345, accounting for the loads occurring during transition from one flap position and airspeed to another.

§ 25.459 Special devices.

The loading for special devices using aerodynamic surfaces (such as slots and spoilers) must be determined from test data.

GROUND LOADS

§ 25.471 General.

(a) *Loads and equilibrium.* For limit ground loads—

(1) Limit ground loads obtained under this subpart are considered to be external forces applied to the airplane structure; and

(2) In each specified ground load condition, the external loads must be placed in equilibrium with the linear and angular inertia loads in a rational or conservative manner.

(b) *Critical centers of gravity.* The critical centers of gravity within the range for which certification is requested must be selected so that the maximum design loads are obtained in each landing gear element. Fore and aft, vertical, and lateral airplane centers of gravity must be considered. Lateral displacements of the c.g. from the airplane centerline which would result in main gear loads not greater than 103 percent of the critical design load for symmetrical loading conditions may be selected without considering the effects of these lateral c.g. displacements on the loading of the main gear elements, or on the airplane structure provided—

(1) The lateral displacement of the c.g. results from random passenger or cargo disposition within the fuselage or from random unsymmetrical fuel loading or fuel usage; and

(2) Appropriate loading instructions for random disposable loads are included under the provisions of § 25.1583(c)(1) to ensure that the lateral displacement of the center of gravity is maintained within these limits.

(c) *Landing gear dimension data.* Figure 1 of Appendix A contains the basic landing gear dimension data.

§ 25.473 Ground load conditions and assumptions.

(a) For the landing conditions specified in §§ 25.479 through 25.485, the following apply:

(1) The selected limit vertical inertia load factors at the center of gravity of the airplane may not be less than the values that would be obtained—

(i) In the attitude and subject to the drag loads associated with the particular landing condition;

(ii) With a limit descent velocity of 10 f.p.s. at the design landing weight (the maximum weight for landing conditions at the maximum descent velocity); and

(iii) With a limit descent velocity of 6 f.p.s. at the design takeoff weight (the maximum weight for landing conditions at a reduced descent velocity.

(2) Airplane lift, not exceeding the airplane weight, may be assumed to exist throughout the landing impact and to act through the center of gravity of the airplane.

(b) The prescribed descent velocities may be modified if it is shown that the airplane has design features that make it impossible to develop these velocities.

(c) The minimum limit inertia load factors corresponding to the required limit descent velocities must be determined in accordance with § 25.723(a).

§ 25.477 Landing gear arrangement.

Sections 25.479 through 25.485 apply to airplanes with conventional arrangements of main and nose gears, or main and tail gears, when normal operating techniques are used.

§ 25.479 Level landing conditions.

(a) In the level attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L_1} to 1.25 V_{L_2}, parallel to the ground, and to be subjected to the load factors prescribed in § 25.473(a)(1) with—

(1) V_{L_1} equal to V_{S_0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

(2) V_{L_2} equal to V_{S_0} (TAS) at the appropriate landing weight and altitudes in a hot-day temperature of 41° F. above standard.

(b) The effects of increased contact speeds must be investigated if approval of downwind landings exceeding 10 knots is desired.

(c) Assuming that the following combinations of vertical and drag components act at the axle centerline, the following apply:

(1) For the condition of maximum wheel spin-up load, drag components simulating the forces required to accelerate the wheel rolling assembly up to the specified ground speed must be combined with the vertical ground reactions existing at the instant of peak drag loads. The coefficient of friction between the tires and the ground may be established by considering the effects of skidding velocity and tire pressure. However, this coefficient of friction need not be more than 0.8. This condition must be applied to the landing gear, directly affected attaching structure, and large mass items such as external fuel tanks and nacelles.

(2) For the condition of maximum wheel vertical load, an aft acting drag component of not less than 25 percent of the maximum vertical ground reaction must be combined with the maximum ground reaction of § 25.473.

(3) For the condition of maximum springback load, forward-acting horizontal loads resulting from a rapid reduction of the spin-up drag loads must be combined with the vertical ground reactions at the instant of the peak forward load. This condition must be applied to the landing gear, directly affected attaching structure, and large mass items such as external fuel tanks and nacelles.

(d) For the level landing attitude for airplanes with tail wheels, the conditions specified in paragraphs (a) through (c) of this section must be investigated with the airplane horizontal reference line horizontal in accordance with Figure 2 of Appendix A.

(e) For the level landing attitude for airplanes with nose wheels, shown in Figure 2 of Appendix A, the conditions specified in paragraphs (a) through (c) of this section must be investigated, assuming the following attitudes:

(1) An attitude in which the main wheels are assumed to contact the ground with the nose wheel just clear of the ground.

(2) If reasonably attainable at the specified descent and forward velocities, an attitude in which the nose and main wheels are assumed to contact the ground simultaneously. For this attitude—

(i) The nose and main gear may be separately investigated under the conditions in paragraph (c)(1) and (3) of this section; and

(ii) The pitching moment is assumed, under the condition in paragraph (c)(2) of this section, to be resisted by the nose gear.

§ 25.481 Tail-down landing conditions.

(a) In the tail-down attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L_1} to V_{L_2}, parallel to the ground, and is subjected to the load factors prescribed in § 25.473(a)(1) with—

(1) V_{L_1} equal to V_{S_0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

(2) V_{L_2} equal to V_{S_0} (TAS) at the appropriate landing weight and altitudes in a hot-day temperature of 41° F. above standard.

The combination of vertical and drag components specified in § 25.479(c)(1) and (3) is considered to be acting at the main wheel axle centerline.

(b) For the tail-down landing condition for airplanes with tail wheels, the main and tail wheels are assumed to contact the ground simultaneously, in accordance with Figure 3 of Appendix A. Ground reaction conditions on the tail wheel are assumed to act—

(1) Vertically; and

(2) Up and aft through the axle at 45 degrees to the ground line.

(c) For the tail-down landing condition for airplanes with nose wheels, the airplane is assumed to be at an attitude corresponding to either the stalling angle or the maximum angle allowing clearance with the ground by each part of the airplane other than the main wheels, in accordance with Figure 3 of Appendix A, whichever is less.

§ 25.483 One-wheel landing conditions.

For the one-wheel landing condition, the airplane is assumed to be in the level attitude and to contact the ground on one side of the main landing gear, in accordance with Figure 4 of Appendix A. In this attitude—

(a) The ground reactions must be the same as those obtained on that side under § 25.479(c)(2); and

(b) Each unbalanced external load must be reacted by airplane inertia in a rational or conservative manner.

§ 25.485 Side load conditions.

(a) For the side load condition, the airplane is assumed to be in the level attitude with only the main wheels contacting the ground, in accordance with Figure 5 of Appendix A.

(b) Side loads of 0.8 of the vertical reaction (on one side) acting inward and 0.6 of the vertical reaction (on the other side) acting outward must be combined with one-half of the maximum vertical ground reactions obtained in the level landing conditions. These loads are assumed to be applied at the ground contact point and to be resisted by the inertia of the airplane. The drag loads may be assumed to be zero.

§ 25.487 Rebound landing condition.

(a) The landing gear and its supporting structure must be investigated for the loads occurring during rebound of the airplane from the landing surface.

(b) With the landing gear fully extended and not in contact with the ground, a load factor of 20.0 must act on the unsprung weights of the landing gear. This load factor must act in the direction of motion of the unsprung weights as they reach their limiting positions in extending with relation to the sprung parts of the landing gear.

§ 25.489 Ground handling conditions.

Unless otherwise prescribed, the landing gear and airplane structure must be investigated for the conditions in §§ 25.491 through 25.509 with the airplane at the design ramp weight (the maximum weight for ground handling conditions). No wing lift may be considered. The shock absorbers and tires may be assumed to be in their static position.

§ 25.491 Takeoff run.

The landing gear and the airplane structure are assumed to be subjected to loads not less than those obtained under conditions described in § 25.235.

§ 25.493 Braked roll conditions.

(a) An airplane with a tail wheel is assumed to be in the level attitude with the load on the main wheels, in accordance with Figure 6 of Appendix A. The limit vertical load factor is 1.2 at the design landing weight, and 1.0 at the design ramp weight. A drag reaction equal to the vertical reaction multiplied by a coefficient of friction of 0.8, must be combined with the vertical ground reaction and applied at the ground contact point.

(b) For an airplane with a nose wheel, the limit vertical load factor is 1.2 at the design landing weight, and 1.0 at the design ramp weight. A drag reaction equal to the vertical reaction, multiplied by a coefficient of friction of 0.8, must be combined with the vertical reaction and applied at the ground contact point of each wheel with brakes. The following two attitudes, in accordance with Figure 6 of Appendix A, must be considered:

(1) The level attitude with the wheels contacting the ground and the loads distributed between the main and nose gear. Zero pitching acceleration is assumed.

(2) The level attitude with only the main gear contacting the ground and with the pitching moment resisted by angular acceleration.

(c) A drag reaction lower than that prescribed in paragraphs (a) and (b) of this section may be used if it is substantiated that an effective drag force of 0.8 times the vertical reaction cannot be attained under any likely loading condition.

§ 25.495 Turning.

In the static position, in accordance with Figure 7 of Appendix A, the airplane is assumed to execute a steady turn by nose gear steering, or by application of sufficient differential power, so that the limit load factors applied at the center of gravity are 1.0 vertically and 0.5 laterally. The side ground reaction of each wheel must be 0.5 of the vertical reaction.

§ 25.497 Tail-wheel yawing.

(a) A vertical ground reaction equal to the static load on the tail wheel, in combination with a side component of equal magnitude, is assumed.

(b) If there is a swivel, the tail wheel is assumed to be swiveled 90° to the airplane longitudinal axis with the resultant load passing through the axle.

(c) If there is a lock, steering device, or shimmy damper the tail wheel is also assumed to be in the trailing position with the side load acting at the ground contact point.

§ 25.499 Nose-wheel yaw.

(a) A vertical load factor of 1.0 at the airplane center of gravity, and a side component at the nose wheel ground contact equal to 0.8 of the vertical ground reaction at that point are assumed.

(b) With the airplane assumed to be in static equilibrium with the loads resulting from the use of brakes on one side of the main landing gear, the nose gear, its attaching structure, and the fuselage structure forward of the center of gravity must be designed for the following loads:

(1) A vertical load factor at the center of gravity of 1.0.

(2) A forward acting load at the airplane center of gravity of 0.8 times the vertical load on one main gear.

(3) Side and vertical loads at the ground contact point on the nose gear that are required for static equilibrium.

(4) A side load factor at the airplane center of gravity of zero.

(c) If the loads prescribed in paragraph (b) of this section result in a nose gear side load higher than 0.8 times the vertical nose gear load, the design nose gear side load may be limited to 0.8 times the vertical load, with unbalanced yawing moments assumed to be resisted by airplane inertia forces.

(d) For other than the nose gear, its attaching structure, and the forward fuselage structure the loading conditions are those prescribed in paragraph (b) of this section, except that—

(1) A lower drag reaction may be used if an effective drag force of 0.8 times the vertical reaction cannot be reached under any likely loading condition; and

(2) The forward acting load at the center of gravity need not exceed the maximum drag reaction on one main gear, determined in accordance with § 25.493(b).

[(e) With the airplane at design ramp weight, and the nose gear in any steerable position, the combined application of full normal steering torque and a vertical force equal to the maximum static reaction on the nose gear must be considered in designing the nose gear, its attaching structure, and the forward fuselage structure.]

§ 25.503 Pivoting.

(a) The airplane is assumed to pivot about one side of the main gear with the brakes on that side locked. The limit vertical load factor must be 1.0 and the coefficient of friction 0.8.

(b) The airplane is assumed to be in static equilibrium, with the loads being applied at the ground contact points, in accordance with Figure 8 of Appendix A.

§ 25.507 Reversed braking.

(a) The airplane must be in a three point static ground attitude. Horizontal reactions parallel to the ground and directed forward must be applied at the ground contact point of each wheel with brakes. The limit loads must be equal to 0.55 times the vertical load at each wheel or to the load developed by 1.2 times the nominal maximum static brake torque, whichever is less.

(b) For airplanes with nose wheels, the pitching moment must be balanced by rotational inertia.

(c) For airplanes with tail wheels, the resultant of the ground reactions must pass through the center of gravity of the airplane.

§ 25.509 Towing loads.

(a) The towing loads specified in paragraph (d) of this section must be considered separately. These loads must be applied at the towing fittings and must act parallel to the ground. In addition—

(1) A vertical load factor equal to 1.0 must be considered acting at the center of gravity;

(2) The shock struts and tires must be in their static positions; and

(3) With W_T as the design ramp weight, the towing load, F_{TOW}, is—

(i) 0.3 W_T for W_T less than 30,000 pounds;

(ii) $\frac{6W_T+450,000}{70}$ for W_T between 30,000 and 100,000 pounds; and

(iii) 0.15 W_T for W_T over 100,000 pounds.

(b) For towing points not on the landing gear but near the plane of symmetry of the airplane, the drag and side tow load components specified for the auxiliary gear apply. For towing points located outbroad of the main gear, the drag and side tow load components specified for the main gear apply. Where the specified angle of swivel cannot be reached, the maximum obtainable angle must be used.

(c) The towing loads specified in paragraph (d) of this section must be reacted as follows:

(1) The side component of the towing load at the main gear must be reacted by a side force at the static ground line of the wheel to which the load is applied.

(2) The towing loads at the auxiliary gear and the drag components of the towing loads at the main gear must be reacted as follows:

(i) A reaction with a maximum value equal to the vertical reaction must be applied at the axle of the wheel to which the load is applied. Enough airplane inertia to achieve equilibrium must be applied.

(ii) The loads must be reacted by airplane inertia.

(d) The prescribed towing loads are as follows:

Tow point	Position	Load		
		Magnitude	No.	Direction
Main gear.		0.75 F_{TOW} per main gear unit.	1	Forward, parallel to drag axis.
			2	Forward, at 30° to drag axis.
			3	Aft, parallel to drag axis.
			4	Aft, at 30° to drag axis.
Auxiliary gear.	Swiveled forward.	1.0 F_{TOW}	5	Forward.
			6	Aft.
	Swiveled aft.		7	Forward.
			8	Aft.
	Swiveled 45° from forward.	0.5 F_{TOW}	9	Forward, in plane of wheel.
			10	Aft, in plane of wheel.
	Swiveled 45° from aft.		11	Forward, in plane of wheel.
			12	Aft, in plane of wheel.

§ 25.511 Ground load: unsymmetrical loads on multiple-wheel units.

(a) *General.* Multiple-wheel landing gear units are assumed to be subjected to the limit ground loads prescribed in this subpart under paragraphs (b) through (f) of this section. In addition—

(1) A tandem strut gear arrangement is a multiple-wheel unit; and

(2) In determining the total load on a gear unit with respect to the provisions of paragraphs (b) through (f) of this section, the transverse shift in the load centroid, due to unsymmetrical load distribution on the wheels, may be neglected.

(b) *Distribution of limit loads to wheels; tires inflated.* The distribution of the limit loads among the wheels of the landing gear must be established for each landing, taxiing, and ground handling condition, taking into account the effects of the following factors:

(1) The number of wheels and their physical arrangements. For truck type landing gear units, the effects of any see-saw motion of the truck during the landing impact must be considered in determining the maximum design loads for the fore and aft wheel pairs.

(2) Any differentials in tire diameters resulting from a combination of manufacturing tolerances, tire growth, and tire wear. A maximum tire-diameter differential equal to ⅔ of the most unfavorable combination of diameter variations that is obtained when taking into account manufacturing tolerances, tire growth, and tire wear, may be assumed.

(3) Any unequal tire inflation pressure, assuming the maximum variation to be ±5 percent of the nominal tire inflation pressure.

(4) A runway crown of zero and a runway crown having a convex upward shape that may be approximated by a slope of 1½ percent with the horizontal. Runway crown effects must be considered with the nose gear unit on either slope of the crown.

(5) The airplane attitude.

(6) Any structural deflections.

(c) *Deflated tires.* The effect of deflated tires on the structure must be considered with respect to the loading conditions specified in paragraphs (d) through (f) of this section, taking into account the physical arrangement of the gear components. In addition—

(1) The deflation of any one tire for each multiple wheel landing gear unit, and the deflation of any two critical tires for each landing gear unit using four or more wheels per unit, must be considered; and

(2) The ground reactions must be applied to the wheels with inflated tires except that, for multiple-wheel gear units with more than one shock strut, a rational distribution of the ground reactions between the deflated and inflated tires, accounting for the differences in shock strut extensions resulting from a deflated tire, may be used.

(d) *Landing conditions.* For one and for two deflated tires, the applied load to each gear unit is assumed to be 60 percent and 50 percent, respectively, of the limit load applied to each gear for each of the prescribed landing conditions. However, for the drift landing condition of § 25.485, 100 percent of the vertical load must be applied.

(e) *Taxiing and ground handling conditions.* For one and for two deflated tires—

(1) The applied side or drag load factor, or both factors, at the center of gravity must be the most critical value up to 50 percent and 40 percent, respectively, of the limit side or drag load factors, or both factors, corresponding to the most severe condition resulting from consideration of the prescribed taxiing and ground handling conditions;

(2) For the braked roll conditions of § 25.493(a) and (b)(2), the drag loads on each inflated tire may not be less than those at each tire for the symmetrical load distribution with no deflated tires;

(3) The vertical load factor at the center of gravity must be 60 percent and 50 percent, respectively, of the factor with no deflated tires, except that it may not be less than 1g; and

(4) Pivoting need not be considered.

(f) *Towing conditions.* For one and for two deflated tires, the towing load, F_{TOW}, must be 60 percent and 50 percent, respectively, of the load prescribed.

WATER LOADS

§ 25.521 General.

(a) Seaplanes must be designed for the water loads developed during takeoff and landing, with the seaplane in any attitude likely to occur in normal operation, and at the appropriate forward and sinking velocities under the most severe sea conditions likely to be encountered.

(b) Unless a more rational analysis of the water loads is made, or the standards in ANC-3 are used, §§ 25.523 through 25.537 apply.

(c) The requirements of this section and §§ 25.523 through 25.537 apply also to amphibians.

§ 25.523 Design weights and center of gravity positions.

(a) *Design weights.* The water load requirements must be met at each operating weight up to the design landing weight except, that, for the takeoff condition prescribed in § 25.531, the design water takeoff weight (the maximum weight for water taxi and takeoff run) must be used.

(b) *Center of gravity positions.* The critical centers of gravity within the limits for which certification is requested must be considered to reach maximum design loads for each part of the seaplane structure.

§ 25.525 Application of loads.

(a) Unless otherwise prescribed, the seaplane as a whole is assumed to be subjected to the loads corresponding to the load factors specified in § 25.527.

(b) In applying the loads resulting from the load factors prescribed in § 25.527, the loads may be distributed over the hull or main float bottom (in order to avoid excessive local shear loads and bending moments at the location of water load application) using pressures not less than those prescribed in § 25.533 (b).

(c) For twin float seaplanes, each float must be treated as an equivalent hull on a fictitious seaplane with a weight equal to one-half the weight of the twin float seaplane.

(d) Except in the takeoff condition of § 25.531, the aerodynamic lift on the seaplane during the impact is assumed to be ⅔ of the weight of the seaplane.

§ 25.527 Hull and main float load factors.

(a) Water reaction load factors n_W must be computed in the following manner:

(1) For the step landing case

$$n_W = \frac{C_1 V_{S_0}{}^2}{\tan^{2/3}\beta W^{1/3}}$$

(2) For the bow and stern landing cases

$$n_W = \frac{C_1 V_{S_0}{}^2}{\tan^{2/3}\beta W^{1/3}} \times \frac{K_1}{(1+r_x{}^2)^{2/3}}$$

(b) The following values are used:

(1) n_W = water reaction load factor (that is, the water reaction divided by seaplane weight).

(2) C_1 = empirical seaplane operations factor equal to 0.012 (except that this factor may not be less than that necessary to obtain the minimum value of step load factor of 2.33).

(3) V_{S_0} = seaplane stalling speed in knots with flaps extended in the appropriate landing position and with no slipstream effect.

(4) β = angle of dead rise at the longitudinal station at which the load factor is being determined, in accordance with Figure 1 of Appendix B.

(5) W = seaplane design landing weight in pounds.

(6) K_1 = empirical hull station weighing factor, in accordance with Figure 2 of Appendix B.

(7) r_x = ratio of distance, measured parallel to hull reference axis, from the center of gravity of the seaplane to the hull longitudinal station at which the load factor is being computed to the radius of gyration in pitch of the seaplane, the hull reference axis

being a straight line, in the plane of symmetry, tangential to the keel at the main step.

(c) For a twin float seaplane, because of the effect of flexibility of the attachment of the floats to the seaplane, the factor K_1 may be reduced at the bow and stern to 0.8 of the value shown in Figure 2 of Appendix B. This reduction applies only to the design of the carry-through and seaplane structure.

§ 25.529 Hull and main float landing conditions.

(a) *Symmetrical step, bow, and stern landing.* For symmetrical step, bow, and stern landings, the limit water reaction load factors are those computed under § 25.527. In addition—

(1) For symmetrical step landings, the resultant water load must be applied at the keel, through the center of gravity, and must be directed perpendicularly to the keel line;

(2) For symmetrical bow landings, the resultant water load must be applied at the keel, one-fifth of the longitudinal distance from the bow to the step, and must be directed perpendicularly to the keel line; and

(3) For symmetrical stern landings, the resultant water load must be applied at the keel, at a point 85 percent of the longitudinal distance from the step to the stern post, and must be directed perpendicularly to the keel line.

(b) *Unsymmetrical landing for hull and single float seaplanes.* Unsymmetrical step, bow, and stern landing conditions must be investigated. In addition—

(1) The loading for each condition consists of an upward component and a side component equal, respectively, to 0.75 and 0.25 tan β times the resultant load in the corresponding symmetrical landing condition; and

(2) The point of application and direction of the upward component of the load is the same as that in the symmetrical condition, and the point of application of the side component is at the same longitudinal station as the upward component but is directed inward perpendicularly to the plane of symmetry at a point midway between the keel and chine lines.

(c) *Unsymmetrical landing; twin float seaplanes.* The unsymmetrical loading consists of an upward load at the step of each float of 0.75 and a side load of 0.25 tan β at one float times the step landing load reached under § 25.527. The side load is directed inboard, perpendicularly to the plane of symmetry midway between the keel and chine lines of the float, at the same longitudinal station as the upward load.

§ 25.531 Hull and main float takeoff condition.

For the wing and its attachment to the hull or main float—

(a) The aerodynamic wing lift is assumed to be zero; and

(b) A downward inertia load, corresponding to a load factor computed from the following formula, must be applied:

$$n=\frac{C_{TO}V_{S_1}{}^2}{\tan^{2/3}\beta W^{1/3}}$$

where—

n = inertia load factor;

C_{TO} = empirical seaplane operations factor equal to 0.004;

V_{S_1} = seaplane stalling speed (knots) at the design takeoff weight with the flaps extended in the appropriate takeoff position;

β = angle of dead rise at the main step (degrees); and

W = design water takeoff weight in pounds.

§ 25.533 Hull and main float bottom pressures.

(a) *General.* The hull and main float structure, including frames and bulkheads, stringers, and bottom plating, must be designed under this section.

(b) *Local pressures.* For the design of the bottom plating and stringers and their attachments to the supporting structure, the following pressure distributions must be applied:

(1) For an unflared bottom, the pressure at the chine is 0.75 times the pressure at the keel, and the pressures between the keel and chine vary linearly, in accordance with Figure 3 of Appendix B. The pressure at the keel (p.s.i.) is computed as follows:

$$P_k = C_2 \frac{K_2 V_{S_1}{}^2}{\tan \beta_k}$$

where—

P_k=pressure (p.s.i.) at the chine;

C_2=0.00213;

K_2=hull station weighing factor, in accordance with Figure 2 of Appendix B;

V_{S_1}=seaplane stalling speed (knots) at the design water takeoff weight with flaps extended in the appropriate takeoff position; and

β_k=angle of dead rise at keel, in accordance with Figure 1 of Appendix B.

(2) For a flared bottom, the pressure at the beginning of the flare is the same as that for an unflared bottom, and the pressure between the chine and the beginning of the flare varies linearly, in accordance with Figure 3 of Appendix B. The pressure distribution is the same as that prescribed in subparagraph (1) of this paragraph for an unflared bottom except that the pressure at the chine is computed as follows:

$$P_{ch} = C_3 \frac{K_2 V_{S_1}{}^2}{\tan \beta}$$

where—

P_{ch}=pressure (p.s.i.) at the chine;

C_3=0.0016;

K_2=hull station weighing factor, in accordance with Figure 2 of Appendix B;

V_{S_1}=seaplane stalling speed (knots) at the design water takeoff weight with flaps extended in the appropriate takeoff position; and

β=angle of dead rise at appropriate station.

The area over which these pressures are applied must simulate pressures occurring during high localized impacts on the hull or float, but need not extend over an area that would induce critical stresses in the frames or in the overall structure.

(c) *Distributed pressures.* For the design of the frames, keel, and chine structure, the following pressure distributions apply:

(1) Symmetrical pressures are computed as follows:

$$P = C_4 \frac{K_2 V_{S_0}{}^2}{\tan \beta}$$

where—

P=pressure (p.s.i.);

C_4=0.078 C_1 (with C_1 computed under § 25.527);

K_2=hull station weighing factor, determined in accordance with Figure 2 of Appendix B;

V_{S_0}=seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect; and

β=angle of dead rise at appropriate station.

(2) The unsymmetrical pressure distribution consists of the pressures prescribed in subparagraph (1) of this paragraph on one side of the hull or main float centerline and one-half of that pressure on the other side of the hull or main float centerline, in accordance with Figure 3 of Appendix B.

These pressures are uniform and must be applied simultaneously over the entire hull or main float bottom. The loads obtained must be carried into the sidewall structure of the hull proper, but need not be transmitted in a fore and aft direction as shear and bending loads.

§ 25.535 Auxiliary float loads.

(a) *General.* Auxiliary floats and their attachments and supporting structures must be designed for the conditions prescribed in this section. In the cases specified in paragraphs (b) through (e) of this section, the prescribed water loads may be distributed over the float bottom to avoid excessive local loads, using bottom pressures not less than those prescribed in paragraph (g) of this section.

(b) *Step loading.* The resultant water load must be applied in the plane of symmetry of the float at a point three-fourths of the distance from the bow to the step and must be perpendicular to the keel. The resultant limit load is computed as follows, except that the value of L need not exceed three times the weight of the displaced water when the float is completely submerged:

$$L=\frac{C_s V_{s_0}^{2} W^{2/3}}{\tan^{2/3}\beta_s (1+r_y^2)^{2/3}}$$

where—

L=limit load (lbs.);

C_s=0.0053;

V_{s_0}=seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect;

W=seaplane design landing weight in pounds;

β_s=angle of dead rise at a station ¾ of the distance from the bow to the step, but need not be less than 15 degrees; and

r_y=ratio of the lateral distance between the center of gravity and the plane of symmetry of the float to the radius of gyration in roll.

(c) *Bow loading.* The resultant limit load must be applied in the plane of symmetry of the float at a point one-fourth of the distance from the bow to the step and must be perpendicular to the tangent to the keel line at that point. The magnitude of the resultant load is that specified in paragraph (b) of this section.

(d) *Unsymmetrical step loading.* The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (a) of this section and a side component equal to 0.25 tan β times the load specified in paragraph (b) of this section. The side load must be applied perpendicularly to the plane of symmetry of the float at a point midway between the keel and the chine.

(e) *Unsymmetrical bow loading.* The resultant water load consists of a component equal to 0.75 times the load specified in paragraph (b) of this section and a side component equal to 0.25 tan β times the load specified in paragraph (c) of this section. The side load must be applied perpendicularly to the plane of symmetry at a point midway between the keel and the chine.

(f) *Immersed float condition.* The resultant load must be applied at the centroid of the cross section of the float at a point one-third of the distance from the bow to the step. The limit load components are as follows:

vertical=$\rho g V$.

$$\text{aft}=C_x\frac{\rho}{2}V^{2/3}(KV_{s_0})^2.$$

$$\text{side}=C_y\frac{\rho}{2}V^{2/3}(KV_{s_0})^2.$$

where—

ρ=mass density of water (slugs/ft.^{3});

V=volume of float (ft.^{3});

C_x=coefficient of drag force, equal to 0.133;

C_y=coefficient of side force, equal to 0.106;

K=0.8, except that lower values may be used if it is shown that the floats are incapable of submerging at a speed of 0.8 V_{s_0} in normal operations;

V_{s_0}=seaplane stalling speed (knots) with landing flaps extended in the appropriate position and with no slipstream effect; and

g=acceleration due to gravity (ft/sec^2).

(g) *Float bottom pressures.* The float bottom pressures must be established under § 25.533, except that the value of K_2 in the formulae may be taken as 1.0. The angle of dead rise to be used in determining the float bottom pressures is set forth in paragraph (b) of this section.

§ 25.537 Seawing loads.

Seawing design loads must be based on applicable test data.

EMERGENCY LANDING CONDITIONS

§ 25.561 General.

(a) The airplane, although it may be damaged in emergency landing conditions on land or water, must be designed as prescribed in this section to protect each occupant under those conditions.

(b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury in a minor crash landing when—

(1) Proper use is made of seats, belts, and all other safety design provisions;

(2) The wheels are retracted (where applicable); and

(3) The occupant experiences the following ultimate inertia forces acting separately relative to the surrounding structure:

(i) [Upward, 3.0 *g*.

(ii) Forward, 9.0*g*.

(iii) Sideward, 3.0*g* on the airframe; and 4.0*g* on the seats and their attachments.

(iv) Downward, 6.0*g*,

(v) Rearward, 1.5*g*]

(c) The supporting structure must be designed to restrain, under all loads up to those specified in paragraph (b)(3) of this section, each item of mass that could injure an occupant if it came loose in a minor crash landing.

[(d) Seats and items of mass (and their supporting structure) must not deform under any loads up to those specified in paragraph (b)(3) of this section in an manner that would impede subsequent rapid evacuation of occupants.]

[§ 25.562 Emergency landing dynamic conditions.]

[(a) The seat and restraint system in the airplane must be designed as prescribed in this section to protect each occupant during an emergency landing condition when—

[(1) Proper use is made of seats, safety belts, and shoulder harnesses provided for in the design; and

[(2) The occupant is exposed to loads resulting from the conditions prescribed in this section.

[(b) Each seat type design approved for crew or passenger occupancy during takeoff and landing must successfully complete dynamic tests or be demonstrated by rational analysis based on dynamic tests of a similar type seat, in accordance with each of the following emergency landing conditions. The tests must be conducted with an occupant simulated by a 170-pound anthropomorphic test dummy, as defined by 49 CFR Part 572, Subpart, B, or its equivalent, sitting in the normal upright position.

[(1) A change in downward vertical velocity (ΔV) of not less than 35 feet per second, with the airplane's longitudinal axis canted downward 30 degrees with respect to the horizontal plane and with the wings level. Peak floor deceleration must occur in not more than 0.08 seconds after impact and must reach a minimum of 14g.

[(2) A change in forward longitudinal velocity (ΔV) of not less than 44 feet per second, with the airplane's longitudinal axis horizontal and yawed 10 degrees either right or left, whichever would cause the greatest likelihood of the upper torso restraint system (where installed) moving off the occupant's shoulder, and with the wings level. Peak floor deceleration must occur in not more than 0.09 seconds after impact and must reach a minimum of 16g. Where floor rails or floor fittings are used to attach the seating devices to the test fixture, the rails or fittings must be misaligned with respect to the adjacent set of rails or fittings by at least 10 degrees vertically (i.e., out of parallel) with one rolled 10 degrees.

[(c) The following performance measures must not be exceeded during the dynamic tests conducted in accordance with paragraph (b) of this section:

[(1) Where upper torso straps are used for crewmembers, tension loads in individual straps must not exceed 1,750 pounds. If dual straps are used for restraining the upper torso, the total strap tension loads must not exceed 2,000 pounds.

[(2) The maximum compressive load measured between the pelvis and the lumbar column of the anthropomorphic dummy must not exceed 1,500 pounds.

[(3) The upper torso restraint straps (where installed) must remain on the occupant's shoulder during the impact.

[(4) The lap safety belt must remain on the occupant's pelvis during the impact.

[(5) Each occupant must be protected from serious head injury under the conditions prescribed in paragraph (b) of this section. Where head contact with seats or other structure can occur, protection must be provided so that the head impact does not exceed a Head Injury Criterion (HIC) of 1,000 units. The level of HIC is defined by the equation:

$$HIC = \left\{ (t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt \right]^{2.5} \right\}_{max}$$

Where: t_1 is the initial integration time,

t_2 is the final integration time, and

a(t) is the total acceleration vs. time curve for the head strike, and where

(t) is in seconds, and (a) is in units of gravity (g).

[(6) Where leg injuries may result from contact with seats or other structure, protection must be provided to prevent axially compressive loads exceeding 2,250 pounds in each femur.

[(7) The seat must remain attached at all points of attachment, although the structure may have yielded.

[(8) Seats must no yield under the tests specified in paragraphs (b)(1) and (b)(2) of this section to the extent they would impede rapid evacuation of the airplane occupants.]

§ 25.563 Structural ditching provisions.

Structural strength considerations of ditching provisions must be in accordance with § 25.801(e).

FATIGUE EVALUATION

§ 25.571 Damage-tolerance and fatigue evaluation of structure.

(a) *General.* An evaluation of the strength, detail design, and fabrication must show that catastrophic failure due to fatigue, corrosion, or accidental damage, will be avoided throughout the operational life of the airplane. This evaluation must be conducted in accordance with the provisions of paragraphs (b) and (e) of this section, except as specified in paragraph (c) of this section, for each part of the structure which could contribute to a catastrophic failure (such as wing, empennage, control surfaces and their systems, the fuselage, engine mounting, landing gear, and their related primary attachments). Advisory Circular AC No. 25.571-1 contains guidance information relating to the requirements of this section (copies of the Advisory Circular may be obtained from—U.S. Department of Transportation, Publications Section M-443.1, Washington, D.C. 20590). For turbojet powered airplanes, those parts which could contribute to a catastrophic failure must also be evaluated under paragraph (d) of this section. In addition, the following apply:

(1) Each evaluation required by this section must include—

(i) The typical loading spectra, temperatures, and humidities expected in services;

(ii) The identification of principal structural elements and detail design points, the failure of which could cause catastrophic failure of the airplane; and

(iii) An analysis, supported by test evidence, of the principal structural elements and detail design points identified in paragraph (a) (1) (ii) of this section.

(2) The service history of airplanes of similar structural design, taking due account of differences in operating conditions and procedures, may be used in the evaluations required by this section.

(3) Based on the evaluations required by this section, inspections or other procedures must be established as necessary to prevent catastrophic failure, and must be included in the Airworthiness Limitations section of the Instructions for Continued Airworthiness required by § 25.1529.

(b) *Damage-tolerance (fail-safe) evaluation.* The evaluation must include a determination of the probable locations and modes of damage due to fatigue, corrosion, or accidental damage. The determination must be by analysis supported by test evidence and (if available) service experience. Damage at multiple sites due to prior fatigue exposure must be included where the design is such that this type of damage can be expected to occur. The evaluation must incorporate repeated load and static analyses supported by test evidence. The extent of damage for residual strength evaluation at any time within the operational life must be consistent with the initial detectability and subsequent growth under repeated loads. The residual strength evaluation must show that the remaining structure is able to withstand loads (considered as static ultimate loads) corresponding to the following conditions:

(1) The limit symmetrical maneuvering conditions specified in § 25.337 at V_C and in § 25.345.

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[(2) The limit gust conditions specified in §§ 25.341 and 25.351(b) at the specified speeds up to V_c, and in § 25.345.

[(3) The limit rolling conditions specified in § 25.349 and the limit unsymmetrical conditions specified in §§ 25.367 and 25.427, at speeds up to V_c.

[(4) The limit yaw maneuvering conditions specified in § 25.351(a) at the specified speeds up to V_c.

[(5) For pressurized cabins, the following conditions:

[(i) The normal operating differential pressure combined with the expected external aerodynamic pressures applied simultaneously with the flight loading conditions specified in paragraphs (b)(1) through (4) of this section, if they have a significant effect.

[(ii) The expected external aerodynamic pressures in 1g flight combined with a cabin differential pressure equal to 1.1 times the normal operating differential pressure without any other load.

[(6) For landing gear and directly-affected airframe structure, the limit ground loading conditions specified in §§ 25.473, 25.491, and 25.493.

[If significant changes in structural stiffness or geometry, or both, follow from a structural failure, or partial failure, the effect on damage tolerance must be further investigated.

[(c) *Fatigue (safe-life) evaluation.* Compliance with the damage-tolerance requirements of paragraph (b) of this section is not required if the applicant establishes that their application for particular structure is impractical. This structure must be shown by analysis, supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected during its service life without detectable cracks. Appropriate safe-life scatter factors must be applied.

[(d) *Sonic fatigue strength.* It must be shown by analysis, supported by test evidence, or by the service history of airplanes of similar structural design and sonic excitation environment, that—

[(1) Sonic fatigue cracks are not probable in any part of the flight structure to sonic excitation; or

[(2) Catastrophic failure caused by sonic cracks is not probable assuming that the loads prescribed in paragraph (b) of this section are applied to all areas affected by those cracks.

[(e) *Damage-tolerance (discrete source) evaluation.* The airplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of—

[(1) Impact with a 4-pound bird at likely operational speeds at altitudes up to 8,000 feet;

[(2) Propeller and uncontained fan blade impact;

[(3) Uncontained engine failure; or

[(4) Uncontained high energy rotating machinery failure.

[The damaged structure must be able to withstand the static loads (considered as ultimate loads) which are reasonably expected to occur on the flight. Dynamic effects on these static loads need not be considered. Corrective action to be taken by the pilot following the incident, such as limiting maneuvers, avoiding turbulence, and reducing speed, must be considered. If significant changes in structural stiffness or geometry, or both, follow from a structural failure or partial failure, the effect on damage tolerance must be further investigated.

[§ 25.573 [Reserved.]]

LIGHTNING PROTECTION

§ 25.581 Lightning protection.

(a) The airplane must be protected against catastrophic effects from lightning.

(b) For metallic components, compliance with paragraph (a) of this section may be shown by—

(1) Bonding the components properly to the airframe; or

(2) Designing the components so that a strike will not endanger the airplane.

(c) For nonmetallic components, compliance with paragraph (a) of this section may be shown by—

(1) Designing the components to minimize the effect of a strike; or

(2) Incorporating acceptable means of diverting the resulting electrical current so as not to endanger the airplane.

Subpart D—Design and Construction

GENERAL

§ 25.601 General.

The airplane may not have design features or details that experience has shown to be hazardous or unreliable. The suitability of each questionable design detail and part must be established by tests.

§ 25.603 Materials.

The suitability and durability of materials used for parts, the failure of which could adversely affect safety, must—

(a) Be established on the basis of experience or tests;

(b) Conform to approveed specifications (such as industry or military specifications, or Technical Standard Orders) that ensure their having the strength and other properties assumed in the design data [; and

[(c) Take into account the effects of environmental conditions, such as temperature and humidity, expected in service.]

§ 25.605 Fabrication methods.

[(a)] The methods of fabrication used must produce a consistently sound structure. If a fabrication process (such as gluing, spot welding, or heat treating) requires close control to reach this objective, the process must be performed under an approved process specification.

[(b) Each new aircraft fabrication method must be substantiated by a test program.]

§ 25.607 Fasteners.

(a) Each removable bolt, screw, nut, pin, or other removable fastener must incorporate two separate locking devices if—

(1) Its loss could preclude continued flight and landing within the design limitations of the airplane using normal pilot skill and strength; or

(2) Its loss could result in reduction in pitch, yaw, or roll control capability or response below that required by Subpart B of this Chapter.

(b) The fasteners specified in paragraph (a) of this section and their locking devices may not be adversely affected by the environmental conditions associated with the particular installation.

(c) No self-locking nut may be used on any bolt subject to rotation in operation unless a non-friction locking device is used in addition to the self-locking device.

§ 25.609 Protection of structure.

Each part of the structure must—

(a) Be suitably protected against deterioration or loss of strength in service due to any cause, including—

(1) Weathering;

(2) Corrosion; and

(3) Abrasion; and

(b) Have provisions for ventilation and drainage where necessary for protection.

§ 25.611 Accessibility provisions.

Means must be provided to allow inspection (including inspection of principal structural elements and control systems), replacement of parts normally requiring replacement, adjustment, and lubrication as necessary for continued airworthiness. The inspection means for each item must be practicable for the inspection interval for the item. Non-destructive inspection aids may be used to inspect structural elements where it is impracticable to provide means for direct visual inspection if it is shown that the inspection is effective and the inspection procedures are specified in the maintenance manual required by § 25.1529.

§ 25.613 Material strength properties and design values.

(a) Material strength properties must be based on enough tests of material meeting approved specifications to establish design values on a statistical basis.

(b) Design values must be chosen so that the probability of any structure being understrength because of material variations is extremely remote.

(c) The effects of temperature on allowable stresses used for design in an essential component or structure must be considered where thermal effects are significant under normal operating conditions.

(d) The strength, detail design, and fabrication of the structure must minimize the probability of disastrous fatigue failure, particularly at points of stress concentration.

[(e) Design values must be those contained in the following publications (obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402) or other values approved by the Administrator:]

MIL-HDBK-5, "Metallic Materials and Elements for Flight Vehicle Structure";

MIL-HDBK-17, "Plastics for Flight Vehicles";

ANC-18, "Design of Wood Aircraft Structures"; and

MIL-HDBK-23, "Composite Construction for Flight Vehicles".

§ 25.615 Design properties.

(a) Design properties outlined in MIL-HDBK-5 may be used subject to the following conditions:

(1) Where applied loads are eventually distributed through a single member within an assembly, the failure of which would result in the loss of the structural integrity of the component involved, the guaranteed minimum design mechanical properties ("A" values) when listed in MIL-HDBK-5 must be met.

(2) Redundant structures, in which the failure of individual elements would result in applied loads being safely distributed to other load-carrying members, may be designed on the basis of the "90 percent probability ("B" values)" when listed in MIL-HDBK-5.

(b) Design values greater than the guaranteed minimums required by paragraph (a) of this section may be used where only guaranteed minimum values are normally allowed if a "premium selection" of the material is made in which a specimen of each individual item is tested before use to determine that the actual strength properties of that particular item will equal or exceed those used in design.

§ 25.619 Special factors.

The factor of safety prescribed in § 25.303 must be multiplied by the highest pertinent special factor of safety prescribed in §§ 25.621 through 25.625 for each part of the structure whose strength is—

(a) Uncertain:

(b) Likely to deteriorate in service before normal replacement; or

(c) Subject to appreciable variability because of uncertainties in manufacturing processes or inspection methods.

§ 25.621 Casting factors.

(a) *General.* The factors, tests, and inspections specified in paragraphs (b) through (d) of this section must be applied in addition to those necessary to establish foundry quality control. The inspections must meet approved specifications. Paragraphs (c) and (d) of this section apply to any structural castings except castings that are pressure tested as parts of hydraulic or other fluid systems and do not support structural loads.

(b) *Bearing stresses and surfaces.* The casting factors specified in paragraphs (c) and (d) of this section—

(1) Need not exceed 1.25 with respect to bearing stresses regardless of the method of inspection used; and

(2) Need not be used with respect to the bearing surfaces of a part whose bearing factor is larger than the applicable casting factor.

(c) *Critical castings.* For each casting whose failure would preclude continued safe flight and landing of the airplane or result in serious injury to occupants, the following apply:

(1) Each critical casting must—

(i) Have a casting factor of not less than 1.25; and

(ii) Receive 100 percent inspection by visual, radiographic, and magnetic particle or penetrant inspection methods or approved equivalent nondestructive inspection methods.

(2) For each critical casting with a casting factor less than 1.50, three sample castings must be static tested and shown to meet—

(i) The strength requirements of § 25.305 at an ultimate load corresponding to a casting factor of 1.25; and

(ii) The deformation requirements of § 25.305 at a load of 1.15 times the limit load.

(3) Examples of these castings are structural attachment fittings, parts of flight control systems, control surface hinges and balance weight attachments, seat, berth, safety belt, and fuel and oil tank supports and attachments, and cabin pressure valves.

(d) *Noncritical castings.* For each casting other than those specified in paragraph (c) of this section, the following apply:

(1) Except as provided in subparagraphs (2) and (3) of this paragraph, the casting factors and corresponding inspections must meet the following table:

Casting factor	*Inspection*
2.0 or more	100 percent visual.
Less than 2.0 but more than 1.5.	100 percent visual, and magnetic particle or penetrant or equivalent nondestructive inspection methods.
1.25 through 1.50.	100 percent visual, magnetic particle or penetrant, and radiographic, or approved equivalent nondestructive inspection methods.

(2) The percentage of castings inspected by nonvisual methods may be reduced below that specified in subparagraph (1) of this paragraph when an approved quality control procedure is established.

(3) For castings procured to a specification that guarantees the mechanical properties of the material in the casting and provides for demonstration of these properties by test of coupons cut from the castings on a sampling basis—

(i) A casting factor of 1.0 may be used; and

(ii) The castings must be inspected as provided in subparagraph (1) of this paragraph for casting factors of "1.25 through 1.50" and tested under paragraph (c)(2) of this section.

§ 25.623 Bearing factors.

(a) Except as provided in paragraph (b) of this section, each part that has clearance (free fit), and that is subject to pounding or vibration, must have a bearing factor large enough to provide for the effects of normal relative motion.

(b) No bearing factor need be used for a part for which any larger special factor is prescribed.

§ 25.625 Fitting factors.

For each fitting (a part or terminal used to join one structural member to another), the following apply:

(a) For each fitting whose strength is not proven by limit and ultimate load tests in which actual stress conditions are simulated in the fitting and surrounding structures, a fitting factor of at least 1.15 must be applied to each part of—

(1) The fitting;

(2) The means of attachment; and

(3) The bearing on the joined members.

(b) No fitting factor need be used—

(1) For joints made under approved practices and based on comprehensive test data (such as continuous joints in metal plating, welded joints, and scarf joints in wood); or

(2) With respect to any bearing surface for which a larger special factor is used.

(c) For each integral fitting, the part must be treated as a fitting up to the point at which the section properties become typical of the member.

(d) For each seat, berth, safety belt, and harness, the fitting factors specified in §§ 25.785(i)(3) and 25.1413(c) apply.

§ 25.629 Flutter, deformation, and fail-safe criteria.

(a) *General.* Compliance with this section must be shown by calculations, resonance tests, or other tests found necessary by the Administrator. Full scale flight flutter tests at speeds up to V_{DF}/M_{DF} for the critical airplane flutter modes must be conducted when—

(1) M_D is equal to or greater than 0.8M;

(2) The adequacy of flutter analysis and wind tunnel tests have not been established by previous experience with aircraft having similar design features; or

(3) The conditions specified in subparagraph (1) or (2) of this paragraph exist, and modifications to the type design have a significant effect on the critical flutter modes.

(b) *Flutter and divergence prevention.* The dynamic evaluation of the airplane must include an investigation of the significant elastic, inertia, and aerodynamic forces associated with the rotations and displacements of the plane of the propeller. In addition, the following apply:

(1) The airplane must be designed to be free from flutter and divergence (unstable structural distoration due to aerodynamic loading) for all combinations of altitude and speed encompassed by the V_D/M_D versus altitude envelope enlarged at all points by an increase of 20 percent in equivalent airspeed at both constant Mach number and constant altitude, except that Mach effects for Mach numbers greater than 1.0 need not be included when M_D is less than 1.0 at all design altitudes and the following is established—

(i) A proper margin of damping exists at all speeds up to M_D; and

(ii) There is no large and rapid reduction in damping as M_D is approached.

(2) If concentrated balance weights are used on control surfaces, their effectiveness and strength, including supporting structure, must be substantiated.

(c) *Loss of control due to structural deformation.* The airplane must be designed to be free from control reversal and from undue loss of longitudinal, lateral, and directional stability and control, as a result of structural deformation (including that of the control surface covering) at speeds up to the speed prescribed in paragraph (b) of this section for flutter prevention.

(d) *Fail-safe criteria.* The following fail-safe criteria must be met:

[(1) It must be shown, by analysis or tests, that the airplane is free from such flutter or divergence that would preclude safe flight, at any speed up to V_D, after each of the following:

[(i) Each of the failures, malfunctions, or adverse conditions listed in subparagraph (4) of this paragraph.

[(ii) Any other combination of failures not shown to be extremely improbable.]

(2) If a failure, malfunction, or adverse condition described in subparagraph (4) of this paragraph is simulated during a flight test in showing compliance with this paragraph, the maximum speed investigated need not exceed V_{FC} if it is shown, by correlation of the flight test data with other test data or analyses, that hazardous flutter or divergence will not occur at any speed up to V_D.

(3) The structural failures described in subparagraph (4)(i) and (4)(ii) of this paragraph need not be considered in showing compliance with this paragraph if engineering data substantiate that the probability of their occurrence is negligible by showing that the structural element is designed with—

(i) Conservative static strength margins for each ground and flight loading condition specified in this Part; or

(ii) Sufficient fatigue strength for the loading spectrum expected in operation.

(4) The failures, malfunctions, or adverse conditions used to show compliance with this paragraph are as follows:

(i) Failure of any single element of the structure supporting any engine, independently mounted propeller shaft, large auxiliary power unit, or large externally mounted aerodynamic body (such as an external fuel tank).

(ii) Any single failure of the engine structure, on turbopropeller airplanes, that would reduce the yaw or pitch rigidity of the propeller rotational axis.

(iii) Absence of propeller aerodynamic forces resulting from the feathering of any single propeller, and, for airplanes with four or more engines, the feathering of the critical combination of two propellers. In addition, any single feathered propeller must be paired with the failures, specified in subdivision (i) of this subparagraph, involving failure of any single element of the structure supporting any engine or independently mounted propeller shaft, and the failures specified in subdivision (ii) of this subparagraph.

(iv) Any single propeller rotating at the highest likely overspeed.

[(v) Failure of each principal structural element selected for compliance with § 25.571(b). Safety following a failure may be substantiated by showing that losses in rigidity or changes in frequency, mode shape, or damping are within the parameter variations shown to be satisfactory in the flutter and divergence investigations.

[(vi) Any single failure or malfunction, or combinations thereof, in the flight control system considered under §§ 25.671, 25.672, and 25.1309, and any single failure in any flutter damper system. Investigation of forced structural vibration other than flutter, resulting from failures, malfunctions, or adverse conditions in the automatic flight control system may be limited to airspeeds up to V_C.]

§ 25.631 Bird strike damage.

The empennage structure must be designed to assure capability of continued safe flight and landing of the airplane after impact with an 8 pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to V_C at sea level, selected under § 25.335(a). Compliance with this section by provision of redundant structure and protected location of control system elements or protective devices such as splitter plates or energy absorbing material is acceptable. Where compliance is shown by analysis, tests, or both, use of data on airplanes having similar structural design is acceptable.

CONTROL SURFACES

§ 25.651 Proof of strength.

(a) Limit load tests of control surfaces are required. These tests must include the horn or fitting to which the control system is attached.

(b) Compliance with the special factors requirements of §§ 25.619 through 25.625 and 25.657 for control surface hinges must be shown by analysis or individual load tests.

§ 25.655 Installation.

(a) Movable tail surfaces must be installed so that there is no interference between any surfaces when one is held in its extreme position and the others are operated through their full angular movement.

(b) If an adjustable stabilizer is used, it must have stops that will limit its range of travel to the maximum for which the airplane is shown to meet the trim requirements of § 25.161.

§ 25.657 Hinges.

(a) For control surface hinges, including ball, roller, and self-lubricated bearing hinges, the approved rating of the bearing may not be exceeded. For non-standard bearing hinge configurations, the rating must be established on the basis of experience or tests and, in the absence of a rational investigation, a factor of safety of not less than 6.67 must be used with respect to the ultimate bearing strength of the softest material used as a bearing.

(b) Hinges must have enough strength and rigidity for loads parallel to the hinge line.

CONTROL SYSTEMS

§ 25.671 General.

(a) Each control and control system must operate with the ease, smoothness, and positiveness appropriate to its function.

(b) Each element of each flight control system must be designed, or distinctively and permanently marked, to minimize the probability of incorrect assembly that could result in the malfunctioning of the system.

(c) The airplane must be shown by analysis, test, or both, to be capable of continued safe flight and landing after any of the following failures or jamming in the flight control system and surfaces (including trim, lift, drag, and feel systems) within the normal flight envelope, without requiring exceptional piloting skill or strength. Probable malfunctions must have only minor effects on control system operation and must be capable of being readily counteracted by the pilot.

(1) Any single failure, excluding jamming (for example, disconnection or failure of mechanical elements, or structural failure of hydraulic components, such as actuators, control spool housing, and valves).

(2) Any combination of failures not shown to be extremely improbable, excluding jamming (for example, dual electrical or hydraulic system failures, or any single failure in combination with any probable hydraulic or electrical failure).

(3) Any jam in a control position normally encountered during takeoff, climb, cruise, normal turns, descent, and landing unless the jam is shown to be extremely improbable, or can be alleviated. A runaway of a flight control to an adverse position and jam must be accounted for if such runaway and subsequent jamming is not extremely improbable.

(d) The airplane must be designed so that it is controllable if all engines fail. Compliance with this requirement may be shown by analysis where that method has been shown to be reliable.

§ 25.672 Stability augmentation and automatic and power-operated systems.

If the functioning of stability augmentation or other automatic or power-operated systems is necessary to show compliance with the flight characteristics requirements of this Part, such systems must comply with § 25.671 and the following:

(a) A warning which is clearly distinguishable to the pilot under expected flight conditions without requiring his attention must be provided for any failure in the stability augmentation system or in any other automatic or power-operated system which could result in an unsafe condition if the pilot were not aware of the failure. Warning systems must not activate the control systems.

(b) The design of the stability augmentation system or of any other automatic or power-operated system must permit initial counteraction of failures of the type specified in § 25.671(c) without requiring exceptional pilot skill or strength, by either the deactivation of the system, or a failed portion thereof, or by overriding the failure by movement of the flight controls in the normal sense.

(c) It must be shown that after any single failure of the stability augmentation system or any other automatic or power-operated system—

(1) The airplane is safely controllable when the failure or malfunction occurs at any speed or altitude within the approved operating limitations that is critical for the type of failure being considered;

(2) The controllability and maneuverability requirements of this Part are met within a practical operational flight envelope (for example, speed, altitude, normal acceleration, and airplane configurations) which is described in the Airplane Flight Manual; and

(3) The trim, stability, and stall characteristics are not impaired below a level needed to permit continued safe flight and landing.

§ 25.673 Two-control airplanes.

Two-control airplanes must be able to continue safely in flight and landing if any one connecting element in the directional-lateral flight control system fails.

[§ 25.675 Stops.

[(a) Each control system must have stops that positively limit the range of motion of each movable aerodynamic surface controlled by the system.]

(b) Each stop must be located so that wear, slackness, or take-up adjustments will not adversely affect the control characteristics of the airplane because of a change in the range of surface travel.

(c) Each stop must be able to withstand any loads corresponding to the design conditions for the control system.

§ 25.677 Trim systems.

(a) Trim controls must be designed to prevent inadvertent or abrupt operation and to operate in the plane, and with the sense of motion, of the airplane.

(b) There must be means adjacent to the trim control to indicate the direction of the control movement relative to the airplane motion. In addition, there must be clearly visible means to indicate the position of the trim device with respect to the range of adjustment.

(c) Trim control systems must be designed to prevent creeping in flight. Trim tab controls must be irreversible unless the tab is appropriately balanced and shown to be free from flutter.

(d) If an irreversible tab control system is used, the part from the tab to the attachment of the irreversible unit to the airplane structure must consist of a rigid connection.

§ 25.679 Control system gust locks.

(a) There must be a device to prevent damage to the control surfaces (including tabs), and to the control system, from gusts striking the airplane while it is on the ground or water. If the device, when engaged, prevents normal operation of the control surfaces by the pilot, it must—

(1) Automatically disengage when the pilot operates the primary flight controls in a normal manner; or

(2) Limit the operation of the airplane so that the pilot receives unmistakable warning at the start of takeoff.

(b) The device must have means to preclude the possibility of it becoming inadvertently engaged in flight.

§ 25.681 Limit load static tests.

(a) Compliance with the limit load requirements of this Part must be shown by tests in which—

(1) The direction of the test loads produces the most severe loading in the control system; and

(2) Each fitting, pulley, and bracket used in attaching the system to the main structure is included.

(b) Compliance must be shown (by analyses or individual load tests) with the special factor requirements for control system joints subject to angular motion.

§ 25.683 Operation tests.

It must be shown by operation tests that when portions of the control system subject to pilot effort loads are loaded to 80 percent of the limit load specified for the system and the powered portions of the control system are loaded to the maximum load expected in normal operation, the system is free from—

(a) Jamming;

(b) Excessive friction; and

(c) Excessive deflection.

§ 25.685 Control system details.

[(a) Each detail of each control system must be designed and installed to prevent jamming, chafing, and interference from cargo, passengers, loose objects, or the freezing of moisture.]

(b) There must be means in the cockpit to prevent the entry of foreign objects into places where they would jam the system.

(c) There must be means to prevent the slapping of cables or tubes against other parts.

(d) Sections 25.689 and 25.693 apply to cable systems and joints.

§ 25.689 Cable systems.

(a) Each cable, cable fitting, turnbuckle, splice, and pulley must be approved. In addition—

(1) No cable smaller than 1/8 inch in diameter may be used in the aileron, elevator, or rudder systems; and

(2) Each cable system must be designed so that there will be no hazardous change in cable tension throughout the range of travel under operating conditions and temperature variations.

(b) Each kind and size of pulley must correspond to the cable with which it is used. Pulleys and sprockets must have closely fitted guards to prevent the cables and chains from being displaced or fouled. Each pulley must lie in the plane passing through the cable so that the cable does not rub against the pulley flange.

(c) Fairleads must be installed so that they do not cause a change in cable direction of more than three degrees.

(d) Clevis pins subject to load or motion and retained only by cotter pins may not be used in the control system.

(e) Turnbuckles must be attached to parts having angular motion in a manner that will positively prevent binding throughout the range of travel.

(f) There must be provisions for visual inspection of fairleads, pulleys, terminals, and turnbuckles.

§ 25.693 Joints.

Control system joints (in push-pull systems) that are subject to angular motion, except those in ball and roller bearing systems must have a special factor of safety of not less than 3.33 with respect to the ultimate bearing strength of the softest material used as a bearing. This factor may be reduced to 2.0 for joints in cable control systems. For ball or roller bearings, the approved ratings, including those established in MIL-HDBK-5 "Metallic Materials and Elements for Flight Vehicle Structure", may not be exceeded.

§ 25.695 [Revoked.]

§ 25.697 Lift and drag devices, controls.

(a) Each lift device control must be designed so that the pilots can place the device in any takeoff, en route, approach, or landing position [established under § 25.101(d).] Lift and drag devices must maintain the selected positions, except for movement produced by an automatic positioning or load limiting device, without further attention by the pilots.

(b) Each lift and drag device control must be designed and located to make inadvertent operation improbable. Lift and drag devices intended for ground operation only must have means to prevent the inadvertent operation of their controls in flight if that operation could be hazardous.

(c) The rate of motion of the surfaces in response to the operation of the control and the characteristics of the automatic positioning or load limiting device must give satisfactory flight and performance characteristics under steady or changing conditions of airspeed, engine power, and airplane attitude.

(d) The lift device control must be designed to retract the surfaces from the fully extended position, during steady flight at maximum continuous engine power at any speed below $V_F + 9.0$ (knots).

§ 25.699 Lift and drag device indicator.

(a) There must be means to indicate to the pilots the position of each lift or drag device having a separate control in the cockpit to adjust its position. In addition, an indication of unsymmetrical operation or other malfunction in the lift or drag device systems must be provided when such indication is necessary to enable the pilots to prevent or counteract an unsafe flight or ground condition, considering the effects on flight characteristics and performance.

(b) There must be means to indicate to the pilots the takeoff, en route, approach, and landing lift device positions.

(c) If any extension of the lift and drag devices beyond the landing position is possible, the control must be clearly marked to identify the range of extension.

[§ 25.701 Flap interconnection.

[(a) Unless the airplane has safe flight characteristics with the flaps retracted on one side and extended on the other, the motion of flaps on opposite sides of the plane of symmetry must be synchronized by a mechanical interconnection or approved equivalent means.]

(b) If a wing flap interconnection is used, it must be designed to account for the applicable unsymmetrical loads, including those resulting from flight with the engines on one side of the plane of symmetry inoperative and the remaining engines at takeoff power.

(c) For airplanes with flaps that are not subjected to slipstream conditions, the structure must be designed for the loads imposed when the wing flaps on one side are carrying the most severe load occurring in the prescribed symmetrical conditions and those on the other side are carrying not more than 80 percent of that load.

(d) The flap interconnection must be designed for the loads resulting when the flap surfaces on one side of the plane symmetry are jammed and immovable while the surfaces on the other side are free to move and the full power of the surface actuating system is applied.

§ 25.703 Takeoff warning system.

A takeoff warning system must be installed and must meet the following requirements:

(a) The system must provide to the pilots an aural warning that is automatically activated during the initial portion of the takeoff roll if the airplane is in a configuration, including any of the following, that would not allow a safe takeoff:

(1) The wing flaps or leading edge devices are not within the approved range of takeoff positions.

(2) Wing spoilers (except lateral control spoilers meeting the requirements of § 25.671), speed brakes, or longitudinal trim devices are in a position that would not allow a safe takeoff.

(b) The warning required by paragraph (a) of this section must continue until—

(1) The configuration is changed to allow a safe takeoff;

(2) Action is taken by the pilot to terminate the takeoff roll;

(3) The airplane is rotated for takeoff; or

(4) The warning is manually deactivated by the pilot.

(c) The means used to activate the system must function properly throughout the ranges of takeoff weights, altitudes, and temperatures for which certification is requested.

LANDING GEAR

§ 25.721 General.

(a) The main landing gear system must be designed so that if it fails due to overloads during takeoff and landing (assuming the overloads to act in the upward and aft directions), the failure mode is not likely to cause—

(1) For airplanes that have a passenger seating configuration, excluding pilots seats, of nine seats or less, the spillage of enough fuel from any fuel system in the fuselage to constitute a fire hazard; and

(2) For airplanes that have a passenger seating configuration, excluding pilots seats, of 10 seats or more, the spillage of enough fuel from any part of the fuel system to constitute a fire hazard.

(b) Each airplane that has a passenger seating configuration excluding pilots seats, of 10 or more must be designed so that with the airplane under control it can be landed on a paved runway with any one or more landing gear legs not extended without sustaining a structural component failure that is likely to cause the spillage of enough fuel to constitute a fire hazard.

(c) Compliance with the provisions of this section may be shown by analysis or tests, or both.

[§ 25.723 Shock absorption tests.

[(a) It must be shown that the limit load factors selected for design in accordance with § 25.473 for takeoff and landing weights, respectively, will not be exceeded. This must be shown by energy absorption tests except that analysis based on tests conducted on a landing gear system with identical energy absorption characteristics may be used for increases in previously approved takeoff and landing weights.]

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 f.p.s. at design landing weight, assuming airplane lift not greater than the airplane weight acting during the landing impact.

§ 25.725 Limit drop tests.

(a) If compliance with § 25.723(a) is shown by free drop tests, these tests must be made on the complete airplane, or on units consisting of a wheel, tire, and shock absorber, in their proper positions, from free drop heights not less than—

(1) 18.7 inches for the design landing weight conditions; and

(2) 6.7 inches for the design takeoff weight conditions.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to *W*. If the effect of airplane lift is represented in free drop tests by an equivalent reduced mass, the landing gear must be dropped with an effective mass equal to

$$W_e = W\left(\frac{h+(1-L)d}{h+d}\right)$$

where—

W_e = the effective weight to be used in the drop test (lbs.);

h = specified free drop height (inches);

d = deflection under impact of the tire (at the approved inflation pressure) plus the vertical component of the axle travel relative to the drop mass (inches);

$W = W_M$ for main gear units (lbs.), equal to the static weight on that unit with the airplane in the level attitude (with the

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nose wheel clear in the case of nose wheel type airplanes);

$W = W_T$ for tail gate units (lbs.), equal to the static weight on the tail unit with the airplane in the tail-down attitude;

$W = W_N$ for nose wheel units (lbs.), equal to the vertical component of the static reaction that would exist at the nose wheel, assuming that the mass of the airplane acts at the center of gravity and exerts a force of 1.0*g* downward and 0.25*g* forward; and

L = the ratio of the assumed airplane lift to the airplane weight, but not more than 1.0.

(c) The drop test attitude of the landing gear unit and the application of appropriate drag loads during the test must simulate the airplane landing conditions in a manner consistent with the development of a rational or conservative limit load factor value.

(d) The value of d used in the computation of W_e in paragraph (b) of this section may not exceed the value actually obtained in the drop test.

(e) The limit inertia load factor n must be determined from the free drop test in paragraph (b) of this section according to the following formula:

$$n = n_j \frac{W_e}{W} + L$$

where—

n_j = the load factor developed in the drop test (that is, the acceleration dv/dt in g's recorded in the drop test) plus 1.0; and

W_e, W, and L are the same as in the drop test computation.

(f) The value of n determined in paragraph (e) of this section may not be more than the limit inertia load factor used in the landing conditions in § 25.473.

§ 25.727 Reserve energy absorption drop tests.

(a) If compliance with the reserve energy absorption condition specified in § 25.723(b) is shown by free drop tests, the drop height may not be less than 27 inches.

(b) If airplane lift is simulated by air cylinders or by other mechanical means, the weight used for the drop must be equal to W. If the effect of airplane lift is represented in free drop tests by an equivalent reduced mass, the landing gear must be dropped with an effective mass, $W_e = W\left(\frac{h}{h+d}\right)$ where the symbols and other details are the same as in § 25.725(b).

§ 25.729 Retracting mechanism.

(a) *General.* For airplanes with retractable landing gear, the following apply:

(1) The landing gear retracting mechanism, wheel well doors, and supporting structure, must be designed for—

(i) The loads occurring in the flight conditions when the gear is in the retracted position;

(ii) The combination of friction loads, inertia loads, brake torque loads, air loads, and gyroscopic loads resulting from the wheels rotating at a peripheral speed equal to 1.3 V_S (with the flaps in takeoff position at design takeoff weight), occurring during retraction and extension at any airspeed up to 1.6 V_{S_1} with the flaps in the approach position at design landing weight), and

(iii) Any load factor up to those specified in § 25.345(a) for the flaps extended condition.

(2) Unless there are other means to decelerate the airplane in flight at this speed, the landing gear, the retracting mechanism, and the airplane structure (including wheel well doors) must be designed to withstand the flight loads occurring with the landing gear in the extended position at any speed up to 0.67 V_C.

(3) Landing gear doors, their operating mechanism, and their supporting structures must be designed for the yawing maneuvers prescribed for the airplane in addition to the conditions of airspeed and load factor prescribed in subparagraphs (1) and (2) of this paragraph.

(b) *Landing gear lock.* There must be positive means to keep the landing gear extended, in flight and on the ground.

(c) *Emergency operation.* There must be an emergency means for extending the landing gear in the event of—

(1) Any reasonably probable failure in the normal retraction system; or

(2) The failure of any single source of hydraulic, electric, or equivalent energy supply.

(d) *Operation test.* The proper functioning of the retracting mechanism must be shown by operation tests.

(e) *Position indictor and warning device.* If a retractable landing gear is used, there must be a landing gear position indicator (as well as necessary switches to actuate the indicator) or other means to inform the pilot that the gear is secured in the extended (or retracted) position. This means must be designed as follows:

(1) If switches are used, they must be located and coupled to the landing gear mechanical systems in a manner that prevents an erroneous indication of "down and locked" if the landing gear is not in a fully extended position, or of "up and locked" if the landing gear is not in the fully retracted position. The switches may be located where they are operated by the actual landing gear locking latch or device.

(2) Landplanes must have an aural warning device that will function continuously when one or more throttles are closed, if the landing gear is not fully extended and locked.

(3) If there is a manual shutoff for the aural warning device prescribed in paragraph (e)(2) of this section, the warning system must be designed so that, when the warning has been suspended after one or more throttles are closed, subsequent retardation of any throttle to or beyond the position for a normal landing approach will activate the aural warning.

(4) Landplanes must have an aural warning device that will function continuously, when the wing flaps are extended beyond the maximum approach position determined under § 25.67(e), if the gear is not fully extended and locked. There may not be a manual shutoff for this warning device. The flap position sensing unit may be installed at any suitable location. The system for this device may use any part of the system (including the aural warning device) for the device required in subparagraph (2) of this paragraph.

(f) *Protection of equipment in wheel wells.* Equipment that is essential to safe operation of the airplane and that is located in wheel wells must be protected from the damaging effects of—

(1) A bursting tire, unless it is shown that a tire cannot burst from overheat; and

(2) A loose tire tread, unless it is shown that a loose tire tread cannot cause damage.

§ 25.731 Wheels.

(a) Each main and nose wheel must be approved.

(b) The maximum static load rating of each wheel may not be less than the corresponding static ground reation with—

(1) Design takeoff weight; and

(2) Critical center of gravity.

(c) The maximum limit load rating of each wheel must equal or exceed the maximum radial limit load determined under the applicable ground load requirements of this Part.

[§ 25.733 Tires.

[(a) When a landing gear axle is fitted with a single wheel and tire assembly, the wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions and with a load rating approved by the Administrator that is not exceeded under—

[(1) The loads on the main wheel tire, corresponding to the most critical combination of airplane weight (up to the maximum ramp weight), center of gravity position, and the effect of engine thrust reacted by inertia at the airplane center of gravity; and

[(2) The loads corresponding to the ground reactions in paragraph (b) of this section, on the nose wheel tire, except as provided in paragraphs (b)(2) and (b)(3) of this section.

[(b) The applicable ground reactions for nose wheel tires are as follows:

[(1) The static ground reaction for the tire corresponding to the most critical combination of airplane weight (up to maximum ramp weight) and center of gravity position with a force of 1.0*g* acting downward at the center of gravity. This load may not exceed the load rating of the tire.

[(2) The ground reaction of the tire corresponding to the most critical combination of airplane weight (up to maximum landing weight) and center of gravity position combined with forces of 1.0*g* downward and 0.31*g* forward acting at the center of gravity. The reactions in this case must be distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.31 times the vertical load at each wheel with brakes capable of producing this ground reaction. This nose tire load may not exceed 1.5 times the load rating of the tire.

[(3) The ground reaction of the tire corresponding to the most critical combination of airplane weight (up to a maximum ramp weight) and center of gravity position combined with forces of 1.0*g* downward and 0.20*g* forward acting at the center of gravity. The reactions in this case must be distributed to the nose and main wheels by the principles of statics with a drag reaction equal to 0.20 times the vertical load at each wheel with brakes capable of producing this ground reaction. This nose tire load may not exceed 1.5 times the load rating of the tire.

[(c) When a landing gear axle is fitted with more than one wheel and tire assembly, such as dual or dual-tandem, each wheel must be fitted with a suitable tire of proper fit with a speed rating approved by the Administrator that is not exceeded under critical conditions, and with a load rating approved by the Administrator that is not exceeded by—

[(1) 1.07 times the loads specified in paragraph (a)(1) of this section on each main wheel tire; and

[(2) Loads specified in paragraphs (a)(2), (b)(1), (b)(2), and (b)(3) of this section on each nose wheel tire.

[(d) Each tire installed on a retractable landing gear system must, at the maximum size of the tire type expected in service, have a clearance to surrounding structure and systems that is adequate to prevent unintended contact between the tire and any part of the structure or systems.][1]

§ 25.735 Brakes.

(a) Each brake must be approved.

(b) The brake system must be designed and constructed so that, if any connecting or transmitting element (excluding the operating pedal or handle) fails, or if any single source of hydraulic or other brake operating energy supply is lost, it is possible to bring the airplane to rest under conditions specified in [§ 25.125][2] with a mean deceleration during the landing roll of at least 50 percent of that obtained in determining the landing distance as prescribed in that section. Unless the leakage of hydraulic fluid resulting from failure of the sealing elements in hydraulic brakes, the brake drum, shoes, and actuators, (or their equivalents) does not reduce the braking effectiveness below that required by this paragraph, these units are considered to be connecting or transmitting elements.

(c) Brake controls may not require excessive control force in their operation.

(d) The airplane must have a parking control that, when set by the pilot, will without further attention, prevent the airplane from rolling on a paved, level runway with takeoff power on the critical engine.

(e) If antiskid devices are installed, the devices and associated systems must be designed so that no single probable malfunction will result in a hazardous loss of braking ability or directional control of the airplane.

(f) The brake kinetic energy capacity rating of each main wheel-brake assembly may not be less than the kinetic energy absorption requirements determined under either of the following methods:

(1) The brake kinetic energy absorption requirements must be based on a rational analysis of the sequence of events expected during operational landings at maximum landing weight. This analysis must include conservative values of airplane speed at which the brakes are applied, braking coefficient of friction between tires and runway, aerodynamic drag, propeller drag or powerplant forward thrust, and (if more critical) the most adverse single engine or propeller malfunction.

[2] [(2) Instead of a rational analysis, the kinetic energy absorption requirements for each main wheel brake assembly may be derived from the following formula, which

[1] (Amdt. 25-49, Eff. 12/31/79;
[2] (Amdt. 25-48, Eff. 12/31/79)

assumes an equal distribution of braking between main wheels:

$$KE = 0.0443\ WV^2/N$$

where—

KE = Kinetic energy per wheel (ft.-lb.);
W = Design landing weight (lb.);
V = Airplane speed in knots. V must be not less than V_{S_0}, the poweroff stalling speed of the airplane at sea level, at the design landing weight, and in the landing configuration; and
N = Number of main wheels with brakes.

The formula must be modified in cases of unequal braking distribution.]

(g) The minimum stalling speed rating of each main wheel-brake assembly (that is, the initial speed used in the dynamometer tests) may not be more than the [*V*] used in the determination of kinetic energy in accordance with paragraph (f) of this section, assuming that the test procedures for wheel-brake assemblies involve a specified rate of deceleration, and, therefore, for the same amount of kinetic energy, the rate of energy absorption (the power absorbing ability of the brake) varies inversely with the initial speed.

§ 25.737 Skis.

Each ski must be approved. The maximum limit load rating of each ski must equal or exceed the maximum limit load determined under the applicable ground load requirements of this Part.

FLOATS AND HULLS

§ 25.751 Main float buoyancy.

Each main float must have—

(a) A buoyance of 80 percent in excess of that required to support the maximum weight of the seaplane or amphibian in fresh water; and

(b) Not less than five watertight compartments approximately equal in volume.

§ 25.753 Main float design.

Each main float must be approved and must meet the requirements of § 25.521.

§ 25.755 Hulls.

(a) Each hull must have enough watertight compartments so that, with any two adjacent compartments flooded, the buoyancy of the hull and auxiliary floats (and wheel tires, if used) provides a margin of positive stability great enough to minimize the probability of capsizing in rough, fresh water.

(b) Bulkheads with watertight doors may be used for communication between compartments.

PERSONNEL AND CARGO ACCOMMODATIONS

§ 25.771 Pilot compartment.

(a) Each pilot compartment and its equipment must allow the minimum flight crew (established under § 25.1523) to perform their duties without unreasonable concentration or fatigue.

(b) The primary controls listed in § 25.779(a), excluding cables and control rods, must be located with respect to the propellers so that no member of the mimimum flight crew (established under § 25.1523), or part of the controls, lies in the region between the plane of rotation of any inboard propeller and the surface generated by a line passing through the center of the propeller hub making an angle of five degrees forward or aft of the plane of rotation of the propeller.

(c) If provision is made for a second pilot, the airplane must be controllable with equal safety from either pilot seat.

(d) The pilot compartment must be constructed so that, when flying in rain or snow, it will not leak in a manner that will distract the crew or harm the structure.

(e) Vibration and noise characteristics of cockpit equipment may not interfere with safe operation of the airplane.

§ 25.772 Pilot compartment doors.

(a) Except as provided in paragraph (b) of this section, if a lockable door is installed between the pilot compartment and the passenger compartment to comply with § 121.313(f) of this chapter, the emergency exit configuration of the airplane must be designed so that neither crewmembers nor passengers need use that door in order to reach the emergency exits provided for them. However, for passenger configuration, means must be provided to enable flight crewmembers to directly enter the passenger compartment from the pilot compartment if the cockpit door becomes jammed.

(b) The provisions of paragraph (a) of this section do not apply to an airplane that—

(1) Has a maximum passenger seating configuration of 20 seats or less; or

(2) Is excepted from the equipment requirements of § 121.313(f) under the provisions of § 121.583(a) of this chapter.

§ 25.773 Pilot compartment view.

(a) *Nonprecipitation conditions.* For nonprecipitation conditions, the following apply:

(1) Each pilot compartment must be arranged to give the pilots a sufficiently extensive, clear, and undistorted view, to enable them to safely perform any maneuvers within the operating limitations of the airplane, including taxiing, takeoff, approach, and landing.

(2) Each pilot compartment must be free of glare and reflection that could interfere with the normal duties of the minimum flight crew (established under § 25.1523). This must be shown in day and night flight tests under nonprecipitation conditions.

(b) *Precipitation conditions.* For precipitation conditions, the following apply:

(1) The airplane must have a means to maintain a clear portion of the windshield. during precipitation conditions, sufficient for both pilots to have a sufficiently extensive view along the flight path in normal flight attitudes of the airplane. This means must be designed to function, without continuous attention on the part of the crew, in—

(i) Heavy rain at speeds up to 1.6 V_{S_1}. with flaps retracted; and

(ii) The icing conditions specified in § 25.1419 if certification with ice protection provisions is requested.

(2) The first pilot must have a window that—

(i) When the cabin is not pressurized, is openable under the conditions prescribed in subparagraph (1) of this paragraph and provides the view specified in that paragraph; and

(ii) Gives sufficient protection from the elements against impairment of the pilot's vision.

(c) *Internal windshield and window fogging.* The airplane must have a means to prevent fogging of the internal portions of the windshield and window panels over an area which would provide the visibility specified in paragraph (a) of this section under all internal and external ambient conditions, including precipitation conditions, in which the airplane is intended to be operated.

(d) Fixed markers or other guides must be installed at each pilot station to enable the pilots to position themselves in their seats for an optimum combination of outside visibility and instrument scan. If lighted markers or guides are used they must comply with the requirements specified in § 25.1381.

§ 25.775 Windshields and windows.

(a) Internal panes must be made of nonsplintering material.

(b) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the value of V_C, at sea level, selected under § 25.335(a).

(c) Unless it can be shown by analysis or tests that the probability of occurrence of a critical windshield fragmentation condition is of a low order, the airplane must have a means to minimize the danger to the pilots from flying windshield fragments due to bird impact. This must be shown for each transparent pane in the cockpit that—

(1) Appears in the front view of the airplane;

(2) Is inclined 15 degrees or more to the longitudinal axis of the airplane; and

(3) Has any part of the pane located where its fragmentation will constitute a hazard to the pilots.

(d) The design of windshields and windows in pressurized airplanes must be based on factors peculiar to high altitude operation, including the effects of continuous and cyclic pressurization loadings, the inherent characteristics of the material used, and the effects of temperatures and temperature differentials. The windshield and window panels must be capable of withstanding the maximum cabin pressure differential loads combined with critical aerodynamic pressure and temperature effects after any single failure in the installation or associated systems. It may be assumed that, after a single failure that is obvious to the flight crew (established under § 25.1523), the cabin pressure differential is reduced from the maximum, in accordance with appropriate operating limitations, to allow continued safe flight of the airplane with a cabin pressure altitude of not more than 15,000 feet.

(e) The windshield panels in front of the pilots must be arranged so that, assuming the loss of vision through any one panel, one or more panels remain available for use by a pilot seated at a pilot station to permit continued safe flight and landing.

§ 25.777 Cockpit controls.

(a) Each cockpit control must be located to provide convenient operation and to prevent confusion and inadvertent operation.

(b) The direction of movement of cockpit controls must meet the requirements of § 25.779. Wherever practicable, the sense of motion involved in the operation of other controls must correspond to the sense of the effect of the operation upon the airplane or upon the part operated. Controls of a variable nature using a rotary motion must move clockwise from the off position, through an increasing range, to the full on position.

(c) The controls must be located and arranged, with respect to the pilots' seats, so that there is full and unrestricted movement of each control without interference from the cockpit structure or the clothing of the minimum flight crew (established under § 25.1523) when any member of this flight crew, from 5′2″ to [6′3″] in height, is seated with the seat [belt and shoulder harness (if provided)] fastened.

(d) Identical powerplant controls for each engine must be located to prevent confusion as to the engines they control.

(e) Wing flap controls and other auxiliary lift device controls must be located on top of the pedestal, aft of the throttles, centrally or to the right of the pedestal centerline, and not less than 10 inches aft of the landing gear control.

(f) The landing gear control must be located forward of the throttles and must be operable by each pilot when seated with seat [belt and shoulder harness (if provided)] fastened.

(g) Control knobs must be shaped in accordance with § 25.781. In addition, the knobs must be of the same color, and this color must contrast with the color of control knobs for other purposes and the surrounding cockpit.

(h) If a flight engineer is required as part of the minimum flight crew (established under § 25.1523), the airplane must have a flight engineer station located and arranged so that the flight crewmembers can perform their functions efficiently and without interfering with each other.

§ 25.779 Motion and effect of cockpit controls.

Cockpit controls must be designed so that they operate in accordance with the following movement and actuation:

(a) Aerodynamic controls:

(1) *Primary.*

Controls	*Motion and effect*
Aileron	Right (clockwise) for right wing down.
Elevator	Rearward for nose up.
Rudder	Right pedal forward for nose right.

(2) *Secondary.*

Controls	*Motion and effect*
Flaps (or auxiliary lift devices).	Forward for flaps up; rearward for flaps down.
Trim tabs (or equivalent).	Rotate to produce similar rotation of the airplane about an axis parallel to the axis of the control.

(b) Powerplant and auxiliary controls:

(1) *Powerplant.*

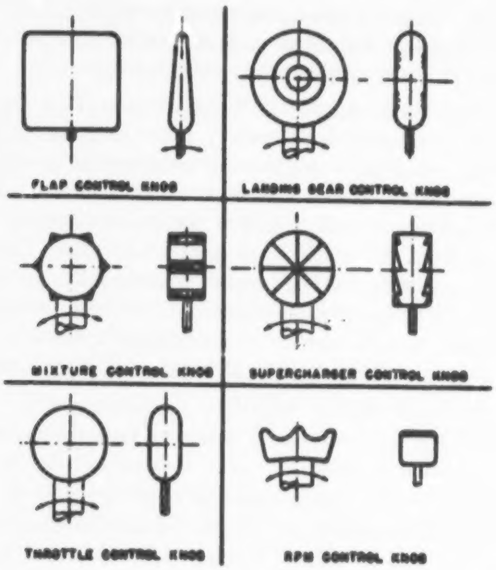
Controls	*Motion and effect*
Throttles	Forward to increase forward thrust and rearward to increase rearward thrust.
Propellers	Forward to increased rpm.
Mixture	Forward or upward for rich.
Carburetor air heat.	Forward or upward for cold.
Supercharger.	Forward or upward for low blower. For turbosuper-chargers, forward, upward, or clockwise, to increase pressure.

(2) *Auxiliary.*

Controls	*Motion and effect*
Landing gear	Down to extend.

§ 25.781 Cockpit control knob shape.

Cockpit control knobs must conform to the general shapes (but not necessarily the exact sizes or specific proportions) in the following figure:



§ 25.783 Doors.

(a) Each cabin must have at least one easily accessible external door.

(b) There must be a means to lock and safeguard each external door against opening in flight (either inadvertently by persons or as a result of mechanical failure or failure of a single structural element [either during or after closure]). Each external door must be openable from both the inside and the outside, even though persons may be crowded against the door on the inside of the airplane. Inward opening doors may be used if there are means to prevent occupants from crowding against the door to an extent that would interfere with the opening of the door. The means of opening must be simple and obvious and must be arranged and marked so that it can be readily located and operated, even in darkness. Auxiliary locking devices may be used.

(c) Each external door must be reasonably free from jamming as a result of fuselage deformation in a minor crash.

(d) Each external door must be located where persons using them will not be endangered by the propellers when appropriate operating procedures are used.

[(e) There must be a provision for direct visual inspection of the locking mechanism to determine if external doors, for which the initial opening movement is not inward (including passenger, crew, service, and cargo doors), are fully closed and locked. The provision must be discernible under operational lighting conditions by appropriate crewmembers using a flashlight or equivalent lighting source. In addition, there must be a visual warning means to signal the appropriate flight crewmembers if any external door is not fully closed and locked. The means must be designed such that any failure or combination of failures that would result in an erroneous closed and locked indication is improbable for doors for which the initial opening movement is not inward.

[(f) External doors must have provisions to prevent the initiation of pressurization of the airplane to an unsafe level if the door is not fully closed and locked. In addition, it must be shown by safety analyst that inadvertent opening is extremely improbable.]

[(g)] Cargo and service doors not suitable for use as an exit in an emergency need only meet paragraph (e) of this section and be safeguarded against opening in flight as a result of mechanical failure or failure of a single structural element.

[(h) Each passenger entry door in the side of the fuselage must qualify as a Type A, Type I, or Type II passenger emergency exit and must meet the requirements of §§ 25.807 through 25.813 that apply to that type of passenger emergency exit.

[(i) If an integral stair is installed in a passenger entry door that is qualified as a passenger emergency exit, the stair must be designed so that under the following conditions the effectiveness of passenger emergency egress will not be impaired:

[(1) The door, integral stair, and operating mechanism have been subjected to the inertia forces specified in § 25.561(b)(3), acting separately relative to the surrounding structure.

(2) The airplane is in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs of the landing gear.

(j) All lavatory doors must be designed to preclude anyone from becoming trapped inside the lavatory, and if a locking mechanism is installed, it be capable of being unlocked from the outside without the aid of special tools.

§ 25.785 Seats, berths, safety belts, and harnesses.

(a) [Each seat, berth, safety belt, harness, and adjacent part of the airplane at each station designated as occupiable during takeoff and landing must be designed so that a person making proper use of these facilities will not suffer serious injury in an emergency landing as a result of the inertia forces specified in §§ 25.561 and 25.562.]

(b) Each seat and berth must be approved.

(c) Each occupant of a seat that makes more than an 18° angle with the vertical plane containing the airplane centerline, must be protected from head injury by a safety belt and an energy absorbing rest that will support the arms, shoulders, head, and spine, or by a safety belt and shoulder harness that will prevent the head from contacting any injurious object. Each occupant of any other seat must be protected from head injury by a safety belt and, as appropriate to the type, location, and angle of facing of each seat, by one or more of the following:

(1) A shoulder harness that will prevent the head from contacting any injurious object.

(2) The elimination of any injurious object within striking radius of the head.

(3) An energy absorbing rest that will support the arms, shoulders, head, and spine.

(d) If the seat backs do not have a firm hand hold, there must be a hand grip or rail along each aisle to enable occupants to steady themselves while using the aisles in moderately rough air.

(e) Each projecting object that would injure persons seated or moving about the airplane in normal flight must be padded.

(f) Each berth must be designed so that the forward part has a padded end board, canvas diaphragm, or equivalent means, that can withstand the static load reaction of the occupant when subjected to the forward inertia force specified in § 25.561. Berths must be free from corners and protuberances likely to cause serious injury to a person occupying the berth during emergency conditions.

(g) Each seat at a flight deck station must have a combined safety belt and shoulder harness with a single-point release that permits the flight desk occupant, when seated with safety belt and shoulder harness fastened, to perform all of the occupant's necessary flight deck functions. There must be a means to secure each combined safety belt and shoulder harness, when not in use, to prevent interference with the operation of the airplane and with rapid egress in an emergency.

(h) Flight attendant seats in passenger compartments must be near required floor level emergency exits and be equipped with a restraint system consisting of a combined safety belt and shoulder harness unit with a single-point release. There must be means to secure each combined safety belt and shoulder harness, when not in use, to prevent interference with rapid egress in an emergency. In addition—

(1) To the extent possible without compromising their proximity to required floor level emergency exits, flight attendant seats must be located to provide a direct view of the cabin area for which the flight attendant is individually responsible.

(2) Flight attendant seats must—

(i) Either be forward or rearward facing, with an energy absorbing rest that is designed to support the arms, shoulders, head, and spine; and

(ii) Be positioned so that when not in use they will not interfere with the use of passageways and exits.

(i) Each seat, berth, and its supporting structure, must be designed for an occupant weight of 170 pounds, considering the maximum load factors, inertia forces, and reactions between the occupant, seat, and safety belt, harness or both, at each relevant flight and ground load condition (including the emergency landing conditions prescribed in § 25.561). For berths, the forward inertia force must be considered in accordance with paragraph (f) of this section and need not be considered with respect to the safety belt. In addition—

(1) The structural analysis and testing of the seats, berths, and their supporting structures may be determined by—

(i) Assuming that the critical load in the forward, sideward, downward, and rearward directions (as determined from the prescribed flight, ground, and emergency landing conditions) acts separately; and

(ii) Using selected combinations of loads if the required strength in each specified direction is substantiated;

(2) Each pilot seat must be designed for the reactions resulting from the application of the pilot forces prescribed in § 25.395; and

(3) The inertia forces specified in § 25.561 must be multiplied by a factor of 1.33 (instead of the fitting factor prescribed in § 25.625) in determining the strength of the attachment of—

(i) Each seat to the structure; and

(ii) Each belt or harness to the seat or structure.

(j) Each flight attendant seat must be located to minimize the probability of its occupant suffering injury by being struck by items dislodged in a galley, or from a stowage compartment or serving cart. All items expected in these locations in service must be considered.

(k) Each forward observer's seat required by the operating rules must be shown to be suitable for use in conducting the enroute inspections prescribed by § 121.581(a).

§ 25.787 Stowage compartments.

(a) Each compartment for the stowage of cargo, baggage, carry-on articles, and equipment (such as life rafts), and any other stowage compartment must be designed for its placarded maximum weight of contents and for the critical load distribution at the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of § 25.561(b), except that the forces specified in the emergency landing conditions need not be applied to compartments located below, or forward, of all occupants in the airplane. If the airplane has a passenger seating configuration, excluding pilots seats, of 10 seats or more, each stowage compartment in the passenger cabin, except for underseat and overhead compartments for passenger convenience, must be completely enclosed.

(b) There must be a means to prevent the contents in the compartments from becoming a hazard by shifting, under the loads specified in paragraph (a) of this section. For stowage compartments in the passenger and crew cabin, if the means used is a latched door, the design must take into consideration the wear and deterioration expected in service.

(c) If cargo compartment lamps are installed, each lamp must be installed so as to prevent contact between lamp bulb and cargo.

§ 25.789 Retention of items of mass in passenger and crew compartments and galleys.

(a) Means must be provided to prevent each item of mass (that is part of the airplane type design) in a passenger or crew compartment or galley from becoming a hazard by shifting under the appropriate maximum load factors corresponding to the specified flight and ground load conditions, and to the emergency landing conditions of § 25.561(b).

(b) Each interphone restraint system must be designed so that when subjected to the load factors specified in § 25.561(b)(3), the interphone will remain in its stowed position.

§ 25.791 Passenger information signs.

When passenger information signs are installed to comply with the operating rules of this chapter, at least one sign (using either letters or symbols) notifying when smoking is prohibited and one sign (using either letters or symbols) notifying when safety belts should be fastened must, when illuminated, be legible to each person seated in the passenger cabin under all probable conditions of cabin illumination. Signs which notify when safety belts should be fastened and when smoking is prohibited must be so constructed that the crew can turn them on and off.

§ 25.793 Floor surfaces.

The floor surface of all areas which are likely to become wet in service must have slip resistant properties.

EMERGENCY PROVISIONS

§ 25.801 Ditching.

(a) If certification with ditching provisions is requested, the airplane must meet the requirements of this section and §§ 25.807(d), 25.1411, and 25.1415(a).

(b) Each practicable design measure, compatible with the general characteristics of the airplane, must be taken to minimize the probability that in an emergency landing on water, the behavior of the airplane would cause immediate injury to the occupants or would make it impossible for them to escape.

(c) The probable behavior of the airplane in a water landing must be investigated by model tests or by comparison with airplanes of similar configuration for which the ditching characteristics are known. Scoops, flaps, projections, and any other factor likely to affect the hydrodynamic characteristics of the airplane, must be considered.

(d) It must be shown that, under reasonably probable water conditions, the flotation time and trim of the airplane will allow the occupants to leave the airplane and enter the liferafts required by § 25.1415. If compliance with this provision is shown by buoyancy and trim computations, appropriate allowances must be made for probable structural damage and leakage. If the airplane has fuel tanks (with fuel jettisoning provisions) that can reasonably be expected to withstand a ditching without leakage, the jettisonable volume of fuel may be considered as buoyancy volume.

(e) Unless the effects of the collapse of external doors and windows are accounted for in the investigation of the probable behavior of the airplane in a water landing (as prescribed in paragraphs (c) and (d) of this section), the external doors and windows must be designed to withstand the probable maximum local pressures.

§ 25.803 Emergency evacuation.

(a) Each crew and passenger area must have emergency means to allow rapid evacuation in crash landings, with the landing gear extended and retracted, considering the possibility of the airplane being on fire.

(b) Passenger ventral and tail cone exits and any floor level door or exit in the side of the fuselage (other than those leading into a cargo or baggage compartment that is not accessible from the passenger cabin) that is 44 or more inches high and 20 or more inches wide, but not wider than 46 inches, must meet the applicable emergency exit requirements of this section and sections 25.807 through 25.813

(c) Except as provided in paragraph (d) of this section, for airplanes having a seating capacity or more than 44 passengers, it must be shown by actual demonstration that the maximum seating capacity, including the number of crewmembers required by the operating rules for which certification is requested, can be evacuated from the airplane to the ground within 90 seconds. The demonstration must be conducted under the following conditions:

(1) It must be conducted either during the dark of the night or during daylight with the dark of night simulated. If the demonstration is conducted indoors during daylight hours, it must be conducted with each window covered and each door closed to minimize the daylight effect. Illumination on the floor or ground may be used, but it must be kept low and shielded against shining into the airplane's windows or doors.

(2) The airplane must be in a normal attitude with landing gear extended.

(3) Stands or ramps may be used for descent from the wing to the ground, and

safety equipment such as mats or inverted life rafts may be placed on the floor or ground to protect participants. No other equipment that is not part of the airplane's emergency evacuation equipment may be used to aid the participants in reaching the ground.

(4) Except as provided in paragraph (c)(1) of this section, only the airplane's emergency lighting system may provide illumination.

(5) All emergency equipment required for the planned operation of the airplane must be installed.

(6) Each external door and exit, and each internal door or curtain, must be in the takeoff configuration.

(7) Each crewmember must be seated in the normally assigned seat for takeoff and must remain in that seat until receiving the signal for commencement of the demonstration. Each crewmember must be—

(i) For compliance with this section or § 121.291 of this chapter, a member of a regularly scheduled line crew, or

(ii) For compliance with this section a person having knowledge of the operation of exits and emergency equipment.

(8) A representative passenger load of persons in normal health must be used as follows:

(i) At least 30 percent must be females.

(ii) At least 5 percent must be over 60 years of age with a proportionate number of females.

(iii) At least 5 percent but not more than 10 percent, must be children under 12 years of age, prorated through that age group.

(iv) Three life-size dolls, not included as part of the total passenger load, must be carried by passengers to simulate live infants 2 years old or younger.

(v) Crewmembers, mechanics and training personnel, who maintain or operate the airplane in the normal course of their duties, may not be used as passengers.

(9) No passenger may be assigned a specific seat except as the Administrator may require. Except as required by paragraph (c)(12) of this section, no employee of the applicant may be seated next to an emergency exit.

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[(10) Seat belts and shoulder harnesses (as required) must be fastened.

[(11) Before the start of the demonstration approximately one-half of the total average amount of carry-on baggage, blankets, pillows, and other similar articles must be distributed at several locations in the aisles and emergency exits access ways to create minor obstructions.

[(12) Each crewmember must be seated in his normally assigned seat for takeoff and must remain in that seat until receiving the signal for commencement of the demonstration.

[(13) No prior indication may be given to any crewmember or passenger of the particular exits to be used in the demonstration.

[(14) The applicant may not practice, rehearse, or describe the demonstration for the participants nor may any participant have taken part in this type of demonstration within the preceding 6 months.

[(15) The pretakeoff passenger briefing required by § 121.571 of this chapter may be given. The passengers may also be advised to follow directions of crewmembers, but not be instructed on the procedures to be followed in the demonstration.

[(16) If safety equipment as allowed by paragraph (c) (3) of this section is provided, either all passenger and cockpit windows must be blacked out or all of the emergency exits must have safety equipment in order to prevent disclosure of the available emergency exits.

[(17) Not more than 50 percent of the emergency exits in the sides of the fuselage of an airplane that meet all of the requirements applicable to the required emergency exits for that airplane may be used for the demonstration. Exits that are not to be used in the demonstration must have the exit handle deactivated or must be indicated by red lights, red tape, or other acceptable means, placed outside the exits to indicate fire or other reason why they are unusable. The exits to be used must be representative of all of the emergency exits on the airplane and must be designated by the applicant, subject to approval by the Administrator. At least one floor level exit must be used.

[(18) All evacuees, except those using an over-the-wing exit, must leave the airplane by a means provided as part of the airplane's equipment.

[(19) The applicant's approved procedures must be fully utilized during the demonstration.

[(20) The evacuation time period is completed when the last occupant has evacuated the airplane and is on the ground. Provided that the acceptance rate of the stand or ramp is no greater than the acceptance rate of the means available on the airplane for descent from the wing during an actual crash situation, evacuees using stands or ramps allowed by paragraph (c) (3) of this section are considered to be on the ground when they are on the stand or ramp.

[(d) A combination of analysis and tests may be used to show that the airplane is capable of being evacuated within 90 seconds under the conditions specified in § 25.803(c) of this section if the Administrator finds that the combination of analysis and tests will provide data with respect to the emergency evacuation capability of the airplane equivalent to that which would be obtained by actual demonstration.]

(e) An escape route must be established from each overwing emergency exit, and (except for flap surfaces suitable as slides) covered with a slip resistant surface. Except where a means for channeling the flow of evacuees is provided—

(1) The escape route must be at least 42 inches wide at Type A passenger emergency exits and must be at least two feet wide at all other passenger emergency exits, and

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(2) The escape route surface must have a reflectance of at least 80 percent, and must be defined by markings with a surface-to-marking contrast ratio of at least 5:1.

§ 25.805 Flight crew emergency exits.

Except for airplanes with a passenger capacity of 20 or less in which the proximity of passenger emergency exits to the flight crew area offers a convenient and readily accessible means of evacuation for the flight crew, the following apply:

(a) There must be either one exit on each side of the airplane or a top hatch, in the flight crew area.

(b) Each exit must be of sufficient size and must be located so as to allow rapid evacuation of the crew. An exit size and shape of other than at least 19 by 20 inches unobstructed rectangular opening may be used only if exit utility is satisfactorily shown, by a typical flight crewmember, to the Administrator.

§ 25.807 Passenger emergency exits.

(a) *Type and location.* For the purpose of this Part, the types and locations of exits are as follows:

(1) *Type I.* This type must have a rectangular opening of not less than 24 inches wide by 48 inches high, with corner radii not greater than one-third the width of the exit. Type I exits must be floor level exits.

(2) *Type II.* This type must have a rectangular opening of not less than 20 inches wide by 44 inches high, with corner radii not greater than one-third the width of the exit. Type II exits must be floor level exits unless located over the wing, in which case they may not have a step-up inside the airplane of more than 10 inches nor a stepdown outside the airplane of more than 17 inches.

(3) *Type III.* This type must have a rectangular opening of not less than 20 inches wide by 36 inches high, with corner radii not greater than one-third the width of the exit, and with a step-up inside the airplane of not more than 20 inches. If the exit is located over-the-wing the step-down outside the airplane may not exceed 27 inches.

(4) *Type IV.* This type must have a rectangular opening of not less than 19 inches wide by 26 inches high, with corner radii not greater than one-third the width of the exit, located over the wing, with a step-up inside the airplane of not more than 29 inches and a stepdown outside the airplane of not more than 36 inches.

(5) *Ventral.* This type is an exit from the passenger compartment through the pressure shell and the bottom fuselage skin. The dimensions and physical configuration of this type of exit must allow at least the same rate of egress as a Type I with the airplane in the normal ground attitude, with landing gear extended.

(6) *Tail cone.* This type is an aft exit from the passenger compartment through the pressure shell and through an openable cone of the fuselage aft of the pressure shell. The means of opening the tail cone must be simple and obvious, and must employ a single operation.

(7) *Type A.* An emergency exit may be designated as a Type A exit if the following criteria are met:

(i) There must be a rectangular opening not less than 42 inches wide by 72 inches high, with corner radii not greater than one-sixth of the width of the exit.

(ii) It must be a floor level exit.

(iii) Unless there are two or more main (fore and aft) aisles, the exit must be located so that there is passenger flow along the main aisle to that exit from both the forward and aft direction.

(iv) There must be an unobstructed passageway at least 36 inches wide leading from each exit to the nearest main aisle.

(v) If two or more main aisles are provided, there must be unobstructed cross aisles at least 20 inches wide between main aisles. There must be a cross aisle leading directly to each passageway between the exit and the nearest main aisle.

[(vi) There must be at least one flight attendant seat, which meets the requirements of §§ 25.785(h) and (i), adjacent to each such exit.]

(vii) Adequate assist space next to each Type A exit must be provided at each side of the passageway, to allow the crewmember(s) to assist in the evacuation of passengers without reducing the unobstructed width of the passageway below that required by subdivision (iv) of this subparagraph.

(viii) At each non-over-wing exit there must be installed a slide capable of carrying simultaneously two parallel lines of evacuees.

(ix) Each overwing exit having a stepdown must have an assist means unless the exit without an assist means can be shown to have a rate of passenger egress at least equal to that of the same type of non-over-wing exit. If an assist means is required it must be automatically deployed, and automatically erected, concurrent with the opening of the exit and self-supporting within 10 seconds.

Stepdown distance as used in this section means the actual distance between the bottom of the required opening and a usable foothold, extending out from the fuselage, that is large enough to be effective without searching by sight or feel.

(b) *Accessibility.* Each required passenger emergency exit must be accessible to the passengers and located where it will afford the most effective means of passenger evacuation. Openings larger than those specified in this section, whether or not of rectangular shape, may be used if—

(1) The specified rectangular opening can be inscribed within the opening; and

(2) The base of the inscribed rectangular opening meets the specified step-up and step-down heights.

(c) *Passenger emergency exits.* The prescribed exits need not be diametrically opposite each other nor identical in size and location on both sides. They must be distributed as uniformly as practicable taking into account passenger distribution. If only one floor level exit per side is prescribed, and the airplane does not have a tail cone or ventral emergency exit, the floor level exits must be in the rearward part of the passenger compartment, unless another location affords a more effective means of passenger evacuation. Where more than one floor level exit per side must be located near each end of the cabin, except that this provision does not apply to combination cargo/passenger configurations. Exits must be provided as follows:

(1) Except as provided in subparagraphs (2) through (6) of this paragraph, the number and type of passenger emergency exits must be in accordance with the following table:

Passenger seating configuration (crewmember seats not included)	Emergency exits for each side of the fuselage			
	Type I	Type II	Type III	Type IV
1 through 9				1
10 through 19			1	
20 through 39		1	1	
40 through 79	1		1	
80 through 109	1		2	
110 through 139	2		1	
140 through 179	2		2	

(2) An increase in the passenger seating configuration above the maximum permitted under subparagraph (1) of this paragraph but not to exceed a total of 299 seats may be allowed in accordance with the following

table for each additional pair of emergency exits in excess of the minimum number prescribed in subparagraph (1) of this paragraph for 179 passenger seats:

Additional emergency exits (each side of fuselage)	*Increase in passenger seating configuration allowed*
Type A	110
Type I	45
Type II	40
Type III	35

(3) For passenger seating configurations in excess of 299 seats, each emergency exit in the side of the fuselage must be either a Type A or Type I. A passenger seating configuration of 110 seats is allowed for each pair of Type A exits and a passenger seating configuration of 45 seats is allowed for each pair of Type I exits.

(4) If a passenger ventral or tail cone exit is installed and can be shown to allow a rate of egress at least equivalent to that of a Type III exit with the airplane in the most adverse exit opening condition because of the collapse of one or more legs of the landing gear, an increase in the passenger seating configuration beyond the limits specified in subparagraph (1), (2), or (3) of this paragraph may be allowed as follows:

(i) For a ventral exit, 12 additional passenger seats.

(ii) For a tail cone exit incorporating a floor level opening of not less than 20 inches wide by 60 inches high, with corner radii not greater than one-third the width of the exit, in the pressure shell and incorporating an approved assist means in accordance with § 25.809(f)(1), 25 additional passenger seats.

(iii) For a tail cone exit incorporating an opening in the pressure shell which is at least equivalent to a Type III emergency exit with respect to dimensions, step-up and step-down distance, and with the top of the opening not less than 56 inches from the passenger compartment floor, 15 additional passenger seats.

(5) For airplanes on which the vertical location of the wing does not allow the installation of overwing exits, an exit of at least the dimensions of a Type III exit must be installed instead of each Type IV exit required by subparagraph (1) of this paragraph.

(6) Each emergency exit in the passenger compartment in excess of the minimum number of required emergency exits must meet the applicable requirements of §§ 25.809 through 25.812, and must be readily accessible.

(d) *Ditching emergency exits for passengers.* [Whether or not ditching certification is requested, ditching emergency exits must be provided in accordance with the following requirements,] unless the emergency exits required by paragraph (c) of this section already meet them:

(1) For airplanes that have a passenger seating configuration, excluding pilots seats, of nine seats or less, one exit above the waterline in each side of the airplane, meeting at least the dimensions of a Type IV exit.

(2) For airplanes that have a passenger seating configuration, excluding pilots seats, of 10 seats or more, one exit above the waterline in a side of the airplane, meeting at least the dimensions of a Type III exit, for each unit (or part of a unit) of 35 passenger seats, but not less than two such exits in the passenger cabin, with one on each side of the airplane. However, where it has been shown through analysis, ditching demonstrations, or any other tests found necessary by the Administrator, that the evacuation capability of the airplane during ditching is improved by the use of larger exits, or by other means, the passenger seat/exit ratio may be increased.

(3) If side exits cannot be above the waterline, the side exits must be replaced by an equal number of readily accessible overhead hatches of not less than the dimensions of a Type III exit except that, for airplanes with a passenger configuration, excluding pilot seats, of 35 seats or less, the two required Type III side exits need be replaced by only one overhead hatch.

§ 25.809 Emergency exit arrangement.

(a) Each emergency exit, including a flight crew emergency exit, must be a movable door or hatch in the external walls of the fuselage, allowing unobstructed opening to the outside.

(b) Each emergency exit must be openable from the inside and the outside except that sliding window emergency exits in the flight crew area need not be openable from the outside if other approved exits are convenient and readily accessible to the flight crew area. Each emergency exit must be capable of being opened, when there is no fuselage deformation—

(1) With the airplane in the normal ground attitude and in each of the attitudes corresponding to collapse of one or more legs of the landing gear; and

(2) Within ten seconds measured from the time when the opening means is actuated to the time when the exit is fully opened.

(c) The means of opening emergency exits must be simple and obvious and may not require exceptional effort. Internal exit-opening means involving sequence operations (such as operation of two handles or latches or the release of safety catches) may be used for flight crew emergency exits if it can be reasonably established that these means are simple and obvious to crewmembers trained in their use.

(d) There must be a means to lock each emergency exit and to safeguard against its opening in flight, either inadvertently by persons or as a result of mechanical failure. In addition, there must be a means for direct visual inspection of the locking mechanism by crewmembers to determine that each emergency exit, for which the initial opening movement is outward, is fully locked.

(e) There must be provisions to minimize the probability of jamming of the emergency exits resulting from fuselage deformation in a minor crash landing.

(f) Each landplane emergency exit (other than exits located over the wing) more than 6 feet from the ground with the airplane on the ground and the landing gear extended must have an approved means to assist the occupants in descending to the ground as follows:

(1) The assisting means for each passenger emergency exit must be a self-supporting slide or equivalent, and must be designed to meet the following requirements:

(i) It must be automatically deployed and deployment must begin during the interval between the time the exit opening means is actuated from inside the airplane and the time the exit is fully opened. However, each passenger emergency exit which is also a passenger entrance door or a service door must be provided with means to prevent deployment of the assisting means when it is opened from either the inside or outside under non-emergency conditions for normal use.

(ii) It must be automatically erected within 10 seconds after deployment is begun.

[(iii) It must be of such length after full deployment that the lower end is self-supporting on the ground and provides safe evacuation of occupants to the ground after collapse of one or more legs of the landing gear.]

(iv) It must have the capability, in 25-knot winds directed from the most critical angle, to deploy and, with the assistance of only one person, to remain usable after full deployment to evacuate occupants safely to the ground.

(v) For each system installation (mockup or airplane installed), five consecutive deployment and inflation tests must be conducted (per exit) without failure, and at least three tests of each such five-test series must be conducted using a single representative sample of the device. The sample devices must be deployed and inflated by the system's primary means after being subjected to the inertia forces specified in § 25.561(b). If any part of the system fails or does not function properly during the required tests, the cause of the failure or malfunction must be corrected by positive means and after that the full series of five consecutive deployment and inflation tests must be conducted without failure.–

(2) The assisting means for flight crew emergency exits may be a rope or any other means demonstrated to be suitable for the purpose. If the assisting means is a rope, or an approved device equivalent to a rope, it must be—

(i) Attached to the fuselage structure at or above the top of the emergency exit opening, or, for a device at a pilot's emergency exit window, at another approved location if the stowed device, or its attachment, would reduce the pilot's view in flight;

(ii) Able (with its attachment) to withstand a 400-pound static load.

(g) Each emergency exit must be shown by tests, or by a combination of analysis and tests, to meet the requirements of paragraphs (b) and (c) of this section.

(h) If the place on the airplane structure at which the escape route required in § 25.803-(e) terminates is more than six feet from the ground with the airplane on the ground and the landing gear extended, means must be provided to assist evacuees (who have used the overwing exits) to reach the ground. If the escape route is over a flap, the height of the terminal edge must be measured with the flap in the takeoff or landing position, whichever is higher from the ground. The assisting means must be of such length that the lower end is self-supporting on the ground after collapse of any one or more landing gear legs.

(i) If a single power-boost or single power-operated system is the primary system for operating more than one exit in an emergency, each exit must be capable of meeting the requirements of paragraph (b) of this section in the event of failure of the primary system. Manual operation of the exit (after failure of the primary system) is acceptable.

(j) When required by the operating rules for any large passenger-carrying turbojet powered airplane, each ventral exit and tailcone exit must be—

(1) Designed and constructed so that it cannot be opened during flight; and

(2) Marked with a placard readable from a distance of 30 inches and installed at a conspicuous location near the means of opening the exit, stating that the exit has been designed and constructed so that it cannot be opened during flight.

§ 25.811 Emergency exit marking.

(a) Each passenger emergency exit, its means of access, and its means of opening must be conspicuously marked.

(b) The identity and location of each passenger emergency exit must be recognizable from a distance equal to the width of the cabin.

(c) Means must be provided to assist the occupants in locating the exits in conditions of dense smoke.

(d) The location of each passenger emergency exit must be indicated by a sign visible to occupants approaching along the main passenger aisle (or aisles). There must be—

(1) A passenger emergency exit locator sign above the aisle (or aisles) near each passenger emergency exit, or at another overhead location if it is more practical because of low headroom, except that one sign may serve more than one exit if each exit can be seen readily from the sign;

(2) A passenger emergency exit marking sign next to each passenger emergency exit, except that one sign may serve two such exits if they both can be seen readily from the sign; and

(3) A sign on each bulkhead or divider that prevents fore and aft vision along the passenger cabin to indicate emergency exits beyond and obscured by the bulkhead or divider, except that if this is not possible the sign may be placed at another appropriate location.

[(e) The location of the operating handle and instructions for opening exits from the inside of the airplane must be shown in the following manner:

[(1) Each passenger emergency exit must have, on or near the exit, a marking that is readable from a distance of 30 inches.

(2) Each Type I and Type A passenger emergency exit operating handle must—

(i) Be self-illuminated with an initial brightness of at least 160 microlamberts; or

(ii) Be conspicuously located and well illuminated by the emergency lighting even in conditions of occupant crowding at the exit.

(3) Each Type III passenger emergency exit operating handle must be self-illuminated with an initial brightness of at least 160 microlamberts. If the operating handle is covered, self-illuminated cover removal instructions having an initial brightness of at least 160 microlamberts must also be provided.

(4) Each Type A, Type I, and Type II passenger emergency exit with a locking mechanism released by rotary motion of the handle must be marked—

(i) With a red arrow, with a shaft at least three-fourths of an inch wide and a head twice the width of the shaft, extending along at least 70 degrees of arc at a radius approximately equal to three-fourths of the handle length.

(ii) So that the centerline of the exit handle is within ±1 inch of the projected point of the arrow when the handle has reached full travel and has released the locking mechanism, and

(iii) With the word "open" in red letters 1 inch high, placed horizontally near the head of the arrow.

(f) Each emergency exit that is required to be openable from the outside, and its means of opening, must be marked on the outside of the airplane. In addition, the following apply:

(1) The outside marking for each passenger emergency exit in the side of the fuselage must include a 2-inch colored band outlining the exit.

(2) Each outside marking including the band, must have color contrast to be readily distinguishable from the surrounding fuselage surface. The contrast must be such that if the reflectance of the darker color is 15 percent or less, the reflectance of the lighter color must be at least 45 percent. "Reflectance" is the ratio of the luminous flux reflected by a body to the luminous flux it receives. When the reflectance of the darker color is greater than 15 percent, at least a 30-percent difference between its reflectance and the reflectance of the lighter color must be provided.

(3) In the case of exits other than those in the side of the fuselage, such as ventral or tail cone exits, the external means of opening, including instructions if applicable, must be conspicuously marked in red, or bright chrome yellow if the background color is such that red is inconspicuous. When the opening means is located on only one side of the fuselage, a conspicuous marking to that effect must be provided on the other side.

(g) Each sign required by paragraph (d) of this section may use the word "exit" in its legend in place of the term "emergency exit".

§ 25.812 Emergency lighting.

(a) An emergency lighting system, independent of the main lighting system, must be installed. However, the sources of general cabin illumination may be common to both the emergency and the main lighting systems if the power supply to the emergency lighting system is independent of the power supply to the main lighting system. The emergency lighting system must include:

[(1) Illuminated emergency exit marking and locating signs, sources of general cabin illumination, interior lighting in emergency exit areas, and floor proximity escape path marking.]

(2) Exterior emergency lighting.

(b) Emergency exit signs—

(1) For airplanes that have a passenger seating configuration, excluding pilot seats, of 10 seats or more must meet the following requirements:

(i) Each passenger emergency exit locator sign required by § 25.811(d)(1) and each passenger emergency exit marking sign required by § 25.811(d)(2) must have red letters at least 1½ inches high on an illuminated white background, and must have an area of at least 21 square inches excluding the letters. The lighted background-to-letter contrast must be at least 10:1. The letter height to stroke-width ratio may not be more than 7:1 nor less than 6:1. These signs must be internally electrically illuminated with a background brightness of at least 25 foot-lamberts and a high-to-low background contrast no greater than 3:1.

(ii) Each passenger emergency exit sign required by § 25.811(d) (3) must have red letters at least 1½ inches high on a white background having an area of at least 21 square inches excluding the letters. These signs must be internally electrically illuminated or self-illuminated by other than electrical means and must have an initial brightness of at least 400 microlamberts. The colors may be reversed in the case of a sign that is self-illuminated by other than electrical means.

(2) For airplanes that have a passenger seating configuration, excluding pilot seats, of nine seats or less, that are required by § 25.811(d) (1), (2), and (3) must have red letters at least 1 inch high on a white background at least 2 inches high. These signs may be internally electrically illuminated, or self-illuminated by other than electrical means, with an initial brightness of at least 160 microlamberts. The colors may be reversed in the case of a sign that is self-illuminated by other than electrical means.

(c) General illumination in the passenger cabin must be provided so that when measured along the centerline of main passenger aisle(s), and cross aisle(s) between main aisles, at seat armrest height and at 40-inch intervals, the average illumination is not less than 0.05 foot-candle and the illumination at each 40-inch interval is not less than 0.01 foot-candle. A main passenger aisle(s) is considered to extend along the fuselage from the most forward passenger emergency exit or cabin occupant seat, whichever is farther forward, to the most rearward passenger emergency exit or cabin occupant seat, whichever is farther aft.

(d) The floor of the passageway leading to each floor-level passenger emergency exit, between the main aisles and the exit openings, must be provided with illumination that is not less than 0.02 foot-candle measured along a line that is within six inches of and parallel to the floor and is centered on the passenger evacuation path.

[(e) Floor proximity emergency escape path marking must provide emergency evacuation guidance for passengers when all sources of illumination more than 4 feet above the cabin aisle floor are totally obscured. In the dark of the night, the floor proximity emergency escape path marking must enable each passenger to—

[(1) After leaving the passenger seat, visually identify the emergency escape path along the cabin aisle floor to the first exits or pair of exits forward and aft of the seat; and

[(2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 4 feet above the cabin floor.]

[(f)] Except for subsystems provided in accordance with paragraph [(h)] of this section that serve no more than one assist means, are independent of the airplane's main emergency lighting system, and are automatically activated when the assist means is erected, the emergency lighting system must be designed as follows:

(1) The lights must be operable manually from the flight crew station and from a point in the passenger compartment that is readily accessable to a normal flight attendant seat.

(2) There must be a flight crew warning light which illuminates when power is on in the airplane and the emergency lighting control device is not armed.

(3) The cockpit control device must have an "on," "off," and "armed" position so that when armed in the cockpit or turned on at either the cockpit or flight attendant station the lights will either light or remain lighted upon interruption (except and interruption caused by a transverse vertical separation of the fuselage during crash landing) of the airplane's normal electric power. There must be a means to safeguard against inadvertent operation of the control device from the "armed" or "on" positions.

[(g)] Exterior emergency lighting must be provided as follows:

(1) At each overwing emergency exit the illumination must be—

(i) Not less than 0.03 foot-candle (measured normal to the direction of the incident light) on a two-square-foot area where an evacuee is likely to make his first step outside the cabin;

(ii) Not less than 0.05 foot-candle (measured normal to the direction of the incident light) for a minimum width of 42 inches for a Type A overwing emergency exit and of 2 feet for all other overwing emergency exits along the 30 percent of the slip-resistant portion of the escape route required in § 25.803(e) that is farthest from the exit; and

(iii) Not less than 0.03 foot-candle on the ground surface with the landing gear extended (measured normal to the direction of the incident light) where an evacuee using the established escape route would normally make first contact with the ground.

(2) At each non-overwing emergency exit not required by § 25.809(f) to have descent assist means the illumination must be not less than 0.03 foot-candle (measured normal to the direction of the incident light) on the ground surface with the landing gear extended where an evacuee is likely to make his first contact with the ground outside the cabin.

[(h)] The means required in § 25.809(f) (1) and (h) to assist the occupants in descending to the ground must be illuminated so that the erected assist means is visible from the airplane.

(1) If the assist means is illuminated by exterior emergency lighting, it must provide illumination of not less than 0.03 foot-candle (measured normal to the direction of the incident light) at the ground end of the erected assist means where an evacuee using the established escape route would normally make first contact with the ground, with the airplane in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.

(2) If the emergency lighting subsystem illuminating the assist means serves no other assist means, is independent of the airplane's main emergency lighting system, and is automatically activated when the assist means is erected, the lighting provisions—

(i) May not be adversely affected by stowage; and

(ii) Must provide illumination of not less than 0.03 foot-candle (measured normal to the direction of incident light) at the ground end of the erected assist means where an evacuee would normally make first contact with the ground, with the airplane in each of the attitudes corresponding to the collapse of one or more legs of the landing gear.

[(i)] The energy supply to each emergency lighting unit must provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing.

[(j)] If storage batteries are used as the energy supply for the emergency lighting system, they may be recharged from the airplane's main electric power system: *Provided,* That, the charging circuit is designed to preclude inadvertent battery discharge into charging circuit faults.

[(k)] Components of the emergency lighting system, including batteries, wiring relays, lamps, and switches must be capable of normal operation after having been subjected to the inertia forces listed in § 25.561(b).

[(l)] The emergency lighting system must be designed so that after any single transverse vertical separation of the fuselage during crash landing—

(1) Not more than 25 percent of all electrically illuminated emergency lights required by this section are rendered inoperative, in addition to the lights that are directly damaged by the separation;

(2) Each electrically illuminated exit sign required under § 25.811(d) (2) remains operative exclusive of those that are directly damaged by the separation; and

(3) At least one required exterior emergency light for each side of the airplane remains operative exclusive of those that are directly damaged by the separation.

§ 25.813 Emergency exit access.

(a) There must be a passageway between individual passenger areas, and leading from each aisle to each Type I and Type II emergency exit. These passageways must be unobstructed and at least 20 inches wide.

(b) For each passenger emergency exit covered by § 25.809(f), there must be enough space next to the exit to allow a crewmember to assist in the evacuation of passengers without reducing the unobstructed width of the passageway below that required for the exit.

(c) There must be access from each aisle to each Type III or Type IV exit, and—

(1) For airplanes that have a passenger seating configuration, excluding pilot's seats, of 20 or more, the projected opening of the exit provided may not be obstructed and there must be no interference in opening the exit by seats, berths, or other protrusions (including seatbacks in any position) for a distance from that exit not less than the width of the narrowest passenger seat installed on the airplane.

(2) For airplanes that have a passenger seating configuration, excluding pilots seats, of 19 or less, there may be minor obstructions in this region, if there are compensating factors to maintain the effectiveness of the exit.

(d) If it is necessary to pass through a passageway between passenger compartments to reach any required emergency exit from any seat in the passenger cabin, the passageway must be unobstructed. However, curtains may be used if they allow free entry through the passageway.

(e) No door may be installed in any partition between passenger compartments.

(f) If it is necessary to pass through a doorway separating the passenger cabin from other areas to reach any required emergency exit from any passenger seat, the door must have a means to latch it in open position. The latching means must be able to withstand the loads imposed upon it when the door is subjected to the ultimate inertia forces, relative to the surrounding structure, listed in § 25.561(b).

§ 25.815 Width of aisle.

The passenger aisle width at any point between seats must equal or exceed the values in the following table:

Passenger seating capacity	Minimum passenger aisle width (inches)	
	Less than 25 inches from floor	25 inches and more from floor
10 or less	12*	15
11 through 19	12	20
20 or more	15	20

* A narrower width not less than 9 inches may be approved when substantiated by tests found necessary by the Administrator.

§ 25.817 Maximum number of seats abreast.

On airplanes having only one passenger aisle, no more than 3 seats abreast may be placed on each side of the aisle in any one row.

[§ 25.819 Lower deck service compartments (including galleys.)

[For airplanes with a service compartment located below the main deck, which may be occupied during taxi or flight but not during takeoff or landing, the following apply:

[(a) There must be at least two emergency evacuation routes, one at each end of lower deck service compartment or two having sufficient separation within each compartment, which could be used by each occupant or the lower deck service compartment to rapidly evacuate to the main deck under normal and emergency lighting conditions. The routes must provide for the evacuation of incapacitated persons, with assistance. The use of the evacuation routes may not be dependent on any powered device. The routes must be designed to minimize the possibility of blockage which might result from fire, mechanical or structural failure, or persons standing on top of or against the escape routes. In the event the airplane's main power system or compartment main lighting system should fail, emergency illumination for each lower deck service compartment must be automatically provided.

[(b) There must be a means for two-way voice communication between the flight deck and each lower deck service compartment.

[(c) There must be an aural emergency alarm system, audible during normal and emergency conditions, to enable crewmembers on the flight deck and at each required floor level emergency exit to alert occupants of each lower deck service compartment of an emergency situation.

[(d) There must be a means, readily detectable by occupants of each lower deck service compartment, that indicates when seat belts should be fastened.

[(e) If a public address system is installed in the airplane, speakers must be provided in each lower deck service compartment.

[(f) For each occupant permitted in a lower deck service compartment, there must be a forward or aft facing seat which meets the requirements of § 25.785(c) and must be able to withstand maximum flight loads when occupied.

[(g) For each powered lift system installed between a lower deck service compartment and the main deck for the carriage of persons or equipment, or both, the system must meet the following requirements:

[(1) Each lift control switch outside the lift, except emergency stop buttons, must be designed to prevent the activation of the lift if the lift door, or the hatch required by paragraph (g)(3) of this section, or both are open.

[(2) An emergency stop button, that when activated will immediately stop the lift, must be installed within the lift and at each entrance to the lift.

[(3) There must be a hatch capable of being used for evacuating persons from the lift that is openable from inside and outside the lift without tools, with the lift in any position.]

VENTILATION AND HEATING

§ 25.831 Ventilation.

(a) Each passenger and crew compartment must be ventilated, and each crew compartment must have enough fresh air (but not less than 10 cu. ft. per minute per crewmember) to enable crewmembers to perform their duties without undue discomfort or fatigue.

(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapors. In meeting this requirement, the following apply:

(1) Carbon monoxide concentrations in excess of one part in 20,000 parts of air are considered hazardous. For test purposes, any acceptable carbon monoxide detection method may be used.

(2) Carbon dioxide in excess of three percent by volume (sea level equivalent) is considered hazardous in the case of crewmembers. Higher concentrations of carbon dioxide may be allowed in crew compartments if appropriate protective breathing equipment is available.

(c) There must be provisions made to ensure that the conditions prescribed in paragraph (b) of this section are met after reasonably probable failures or malfunctioning of the ventilating, heating, pressurization, or other systems and equipment.

(d) If accumulation of hazardous quantities of smoke in the cockpit area is reasonably probable, smoke evacuation must be readily accomplished, starting with full pressurization and without depressurizing beyond safe limits.

(e) Except as provided in paragraph (f) of this section, means must be provided to enable the occupants of the following compartments and areas to control the temperature and quantity of ventilating air supplied to their compartment or area independently of the temperature and quantity of air supplied to other compartments and areas:

(1) The flight crew compartment.

(2) Crewmember compartments and areas other than the flight crew compartment unless the crewmember compartment or area is ventilated by air interchange with other compartments or areas under all operating conditions.

(f) Means to enable the flight crew to control the temperature and quantity of ventilating air supplied to the flight crew compartment independently of the temperature and quantity of ventilating air supplied to other compartments are not required if all of the following conditions are met:

(1) The total volume of the flight crew and passenger compartments is 800 cubic feet or less.

(2) The air inlets and passages for air to flow between flight crew and passenger compartments are arranged to provide compartment temperatures within 5 degrees F. of each other and adequate ventilation to occupants in both compartments.

(3) The temperature and ventilation controls are accessible to the flight crew.

[§ 25.832 Cabin ozone concentration.

[(a) The airplane cabin ozone concentration during flight must be shown not to exceed—

[(1) 0.25 parts per million by volume, sea level equivalent, at any time above flight level 320; and

[(2) 0.1 parts per million by volume, sea level equivalent, time-weighted average during any 3-hour interval above flight level 270.]

(b) For the purpose of this section, "sea level equivalent" refers to conditions of 25° C and 760 millimeters of mercury pressure.

(c) Compliance with this section must be shown by analysis or tests based on airplane operational procedures and performance limitation, that demonstrate that either—

(1) The airplane cannot be operated at an altitude which would result in cabin ozone concentrations exceeding the limits prescribed by paragraph (a) of this section; or

(2) The airplane ventilation system, including any ozone control equipment, will maintain cabin ozone concentrations at or below the limits prescribed by paragraph (a) of this section.

§ 25.833 Heating systems.

(a) Combustion heaters must be approved and must meet the fire protection requirements of § 25.859.

(b) Engine exhaust heaters must meet the provisions of § 25.1125.

PRESSURIZATION

§ 25.841 Pressurized cabins.

(a) Pressurized cabins and compartments to be occupied must be equipped to provide a cabin pressure altitude of not more than 8,000 feet at the maximum operating altitude of the airplane under normal operating conditions. If certification for operation over 25,000 feet is requested, the airplane must be able to maintain a cabin pressure altitude of not more than 15,000 feet in the event of any reasonably probable failure or malfunction in the pressurization system.

(b) Pressurized cabins must have at least the following valves, controls, and indicators for controlling cabin pressure:

(1) Two pressure relief valves to automatically limit the positive pressure differential to a predetermined valve at the maximum rate of flow delivered by the pressure source. The combined capacity of the relief valve must be large enough so that the failure of any one valve would not cause an appreciable rise in the pressure differential. The pressure differential is positive when the internal pressure is greater than the external.

(2) Two reverse pressure differential relief valves (or their equivalents) to automatically prevent a negative pressure differential that would damage the structure. One valve is enough, however, if it is of a design that reasonably precludes its malfunctioning.

(3) A means by which the pressure differential can be rapidly equalized.

(4) An automatic or manual regulator for controlling the intake or exhaust airflow, or both, for maintaining the required internal pressures and airflow rates.

(5) Instruments at the pilot or flight engineer station to show the pressure differential, the cabin pressure altitude, and the rate of change of the cabin pressure altitude.

(6) Warning indication at the pilot or flight engineer station to indicate when the safe or preset pressure differential and cabin pressure altitude limits are exceeded. Appropriate warning markings on the cabin pressure differential indicator meet the warning requirement for pressure differential limits and an aural or visual signal (in addition to cabin altitude indicating means) meets the warning requirement for cabin pressure altitude limits if it warns the flight crew when the cabin pressure altitude exceeds 10,000 feet.

(7) A warning placard at the pilot or flight engineer station if the structure is not designed for pressure differentials up to the maximum relief valve setting in combination with landing loads.

(8) The pressure sensors necessary to meet the requirements of paragraphs (b)(5) and (b)(6) of this section and § 25.1447(c), must be located and the sensing system designed so that, in the event of loss of cabin pressure in any passenger or crew compartment (including upper and lower lobe galleys), the warning and automatic presentation devices, required by those provisions, will be actuated without any delay that would significantly increase the hazards resulting from decompression.

§ 25.843 Tests for pressurized cabins.

(a) *Strength test.* The complete pressurized cabin, including doors, windows, and valves, must be tested as a pressure vessel for the pressure differential specified in § 25.365(d).

(b) *Functional tests.* The following functional tests must be performed:

(1) Tests of the functioning and capacity of the positive and negative pressure differential valves, and of the emergency release valve, to simulate the effects of closed regulator valves.

(2) Tests of the pressurization system to show proper functioning under each possible condition of pressure, temperature, and moisture, up to the maximum altitude for which certification is requested.

(3) Flight tests, to show the performance of the pressure supply, pressure and flow regulators, indicators, and warning signals, in steady and stepped climbs and descents at rates corresponding to the maximum attainable within the operating limitations of the airplane, up to the maximum altitude for which certification is requested.

(4) Tests of each door and emergency exit, to show that they operate properly after being subjected to the flight tests prescribed in subparagraph (3) of this paragraph.

FIRE PROTECTION

§ 25.851 Fire extinguishers.

(a) *Hand fire extinguishers.* For hand fire extinguishers the following apply:

(1) Each hand extinguisher must be approved.

(2) The types and quantities of each extinguishing agent used must be appropriate to the kinds of fires likely to occur where used.

(3) Each extinguisher for use in a personnel compartment must be designed to minimize the hazard of toxic gas concentrations.

(4) A readily accessible hand fire extinguisher must be available for use in each Class A or Class B cargo compartment.

[(5) There must be at least the following number of hand fire extinguishers conveniently located in passenger compartments:

[*Passenger capacity:*	[*Minimum number of hand fire extinguishers*
7 through 30	1
31 through 60	2
61 or more	3

[(6) There must be at least one hand fire extinguisher conveniently located in the pilot compartment.]

(b) *Built-in fire extinguishers.* If a built-in fire extinguisher system is required—

(1) The capacity of each system, in relation to the volume of the compartment where used and the ventilation rate, must be adequate for any fire likely to occur in that compartment; and

(2) Each system must be installed so that—

(i) No extinguishing agent likely to enter personnel compartments will be hazardous to the occupants; and

(ii) No discharge of the extinguisher can cause structural damage.

§ 25.853 Compartment interiors.

Materials (including finishes or decorative surfaces applied to the materials) used in each compartment occupied by the crew or passengers must meet the following test criteria as applicable:

(a) Interior ceiling panels, interior wall panels, partitions, galley structure, large cabinet walls, structural flooring, and materials used in the construction of stowage compartments (other than underseat stowage compartments and compartments for stowing small items such as magazines and maps) must be self-extinguishing when tested vertically in accordance with the applicable portions of Appendix F of this part, or other approved equivalent methods. The average burn length may not exceed six inches and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of three seconds after falling.

(a-1) [For airplanes with passenger capacity of 20 or more, interior ceiling and wall panels (other than lighting lenses), partitions, and the outer surfaces of galleys, large cabinets, and stowage compartments (other than underseat stowage compartments and compartments for stowing small items, such as magazines and maps) must also meet the test requirements of Parts IV and V of Appendix F of this part, or other approved equivalent method, in addition to the flammability requirements prescribed in paragraph (a) of this Section.]

(b) Floor covering, textiles (including draperies and upholstery), seat cushions, padding, decorative and non-decorative coated fabrics, leather, trays and galley furnishings, electrical conduit, thermal and acoustical insulation and insulation covering, air ducting, joint and edge covering, liners of Class B and E cargo or baggage compartments, floor panels of Class C or D cargo and baggage compartments, insulation blankets, cargo covers, and transparencies, molded and thermoformed parts, air ducting joints, and trim strips (decorative and chafing), that are constructed of materials not covered in paragraph (b-2) of this section, must be self extinguishing when tested vertically in accordance with the applicable portions of Part I of Appendix F of this part, or other approved equivalent methods. The average burn length may not exceed 8 inches, and the average flame time after removal of the flame source may not exceed 15 seconds. Drippings from the test specimen may not continue to flame for more than an average of 5 seconds after falling.

(b-1) Motion picture film must be safety film meeting the Standard Specifications for Safety Photographic Film (PH1.25) (available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018), or and FAA approved equivalent. If the film travels through ducts, the ducts must meet the requirements of paragraph (b) of this section.

(b-2) Acrylic windows and signs, parts constructed in whole or in part of elastomeric materials, edge lighted instrument assemblies consisting of two or more instruments in a common housing, seat belts, shoulder harness, and cargo and baggage tiedown equipment, including containers, bins, pallets, etc., used in passenger or crew compartments may not have an average burn rate greater than 2.5 inches per minute when tested horizontally in accordance with the applicable portions of Appendix F of this Part, or other approved equivalent methods.

(b-3) Except for electrical wire and cable insulation, and for small parts (such as knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, and small electrical parts) that the Administrator finds would not contribute significally to the propagation of a fire, materials in items not specified in paragraphs (a), (b), (b-1), or (b-2) of this section may not have a burn rate greater than 4.0 inches per minute when tested horizontally in accordance with the applicable portions of Appendix F of this Part or other approved equivalent methods.

(c) In addition to meeting the requirements of paragraph (b), seat cushions, except those on flight crewmember seats, must meet the test requiremnts of Part II of Appendix F of this Part, or equivalent.

(d) If smoking is to be prohibited, there must be placard so stating, and if smoking is to be allowed—

(1) There must be an adequate number of self-contained, removable ashtrays; and

(2) Where the crew compartment is separated from the passenger compartment, there must be at least one sign meeting the "No Smoking" sign requirements of § 25.791 notifying all passengers when smoking is prohibited.

(e) Each disposal receptable for towels, paper, or waste must be fully enclosed and constructed of at least fire restraint materials, and must contain fires likely to occur in it under normal use. The ability of the disposal receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service must be demonstrated by test. A placard containing the legible words "No Cigarette Disposal" must be located on or near each disposal receptacle door.

(f) Lavatories must have "No Smoking" or "No Smoking in Lavatory" placards located conspicuously on each side of the entry door, and self-contained removable ashtrays located conspicuously on or near the entry side of each lavatory door, except that one ashtray may serve more than one lavatory door if the ashtray can be seen readily from the cabin side of each lavatory door served. The placards must have red letters at least one-half inch high on a white background of at least one inch high. (A "No Smoking" symbol may be included on the placard.)

§ 25.855 Cargo and baggage compartments.

(a) Thermal and acoustic insulation (including coverings) and liners, used in each cargo and baggage compartment not occupied by passengers or crew, must be constructed of materials that at least meet the requirements set forth in § 25.853(b).

[(a-1) Class B through E cargo or baggage compartments, as defined in § 25.857, must have a liner and the liner must be separate from (but may be attached to) the airplane structure, and must be tested as follows:

[(1) Ceiling and sidewall liner panels of Class C and D compartments must meet the test requirements of Part III of Appendix F of this Part or other approved equivalent methods.

[(2) Floor panels of all compartments and ceiling and sidewall liner panels of Class B and E compartments must be constructed of materials that meet at least the requirements set forth in § 25.853(b). Also, these liner panels must be tested at a 45 degrees angle in accordance with the applicable portions of Part I of Appendix F of this Part or other approved equivalent methods. The flame may not penetrate (pass through) the material during application of the flame or subsequent to its removal. The average flame time after removal of the flame source may not exceed 15 seconds, and the average glow time may not exceed 10 seconds.]

(a-2) Insulation blankets and cargo covers used to protect cargo in compartments not occupied by passengers or crew must be constructed of materials that at least meet the requirements of § 25.853(b), and tiedown equipment (including containers, bins, and pallets) used in each cargo and baggage compartment not occupied by passengers or crew must be constructed of materials that at least meet the requirements set forth in § 25.853(b-3).

(b) No compartment may contain any controls, wiring, lines, equipment, or accessories whose damage or failure would affect safe operation, unless those items are protected so that—

(1) They cannot be damaged by the movement of cargo in the compartment; and

(2) Their breakage or failure will not create a fire hazard.

(c) There must be means to prevent cargo or baggage from interfering with the functioning of the fire-protective features of the compartment.

(d) Sources of heat within the compartment must be shielded and insulated to prevent igniting the cargo.

(e) Cargo compartments must meet one of the class requirements of § 28.857. In addition, flight tests must be conducted to show compliance with the provisions of § 25.857 concerning—

(1) Compartment accessibility;

(2) The entry of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers; and

(3) The dissipation of the extinguishing agent in Class C compartments.

During these tests, it must be shown that no inadvertent operation of smoke or fire detectors in any compartment would occur as a result of fire contained in any one compartment, either during or after extinguishment, unless the extinguishing system floods each such compartment simultaneously.

§ 25.857 Cargo compartment classification.

(a) *Class A.* Class A cargo or baggage compartment is one in which—

(1) The presence of a fire would be easily discovered by a crewmember while at his station; and

(2) Each part of the compartment is easily accessible in flight.

(b) *Class B.* A Class B cargo or baggage compartment is one in which—

(1) There is sufficient access in flight to enable a crew member to effectively reach any part of the compartment with the contents of a hand fire extinguisher;

(2) When the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent, will enter any compartment occupied by the crew or passengers;

(3) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station; and

(4) [Reserved]

(c) *Class C.* A Class C cargo or baggage compartment is one not meeting the requirements for either a Class A or B compartment but in which—

(1) There is a separate approved smoke detector or fire detector system to give warning at the pilot or flight engineer station;

(2) There is an approved built-in fire-extinguishing system controllable from the pilot or flight engineer stations;

(3) There are means to exclude hazardous quantities of smoke, flames, or extinguishing agent, from any compartment occupied by the crew or passengers;

(4) There are means to control ventilation and drafts within the compartment so that the extinguishing agent used can control any fire that may start within the comment; and

(5) [Reserved]

(d) *Class D.* A Class D cargo or baggage compartment is one in which—

(1) A fire occurring in it will be completely confined without endangering the safety of the airplane or the occupants;

(2) There are means to exclude hazardous quantities of smoke, flames, or other noxious gases, from any compartment occupied by the crew or passengers.

(3) Ventilation and drafts are controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits;

(4) [Reserved]

(5) Consideration is given to the effect of heat within the compartment on adjacent critical parts of the airplane.

[(6) The compartment volume does not exceed 1,000 cubic feet.]

For compartments of 500 cu. ft. or less, an airflow of 1500 cu. ft. per hour is acceptable.

(e) *Class E.* A Class E cargo compartment is one on airplanes used only for the carriage of cargo and in which—

(1) [Reserved]

(2) There is a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station;

(3) There are means to shut off the ventilating airflow to, or within, the compartment, and the controls for these means are accessible to the flight crew in the crew compartment;

(4) There are means to exclude hazardous quantities of smoke, flames, or noxious gases, from the flight crew compartment; and

(5) The required crew emergency exits are accessible under any cargo loading condition.

§ 25.858 Cargo compartment fire detection systems.

If certification with cargo compartment fire detection provisions is requested, the following must be met for each cargo compartment with those provisions:

(a) The detection system must provide a visual indication to the flight crew within one minute after the start of a fire.

(b) The system must be capable of detecting a fire at a temperature significantly below that at which the structural integrity of the airplane is substantially decreased.

(c) There must be means to allow the crew to check in flight, the functioning of each fire detector circuit.

(d) The effectiveness of the detection system must be shown for all approved operating configurations and conditions.

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§ 25.859 Combustion heater fire protection.

(a) *Combustion heater fire zones.* The following combustion heater fire zones must be protected from fire in accordance with the applicable provisions of §§ 25.1181 through 25.1191 and 25.1195 through 25.1203:

(1) The region surrounding the heater, if this region contains any flammable fluid system components (excluding the heater fuel system), that could—

(i) Be damaged by heater malfunctioning; or

(ii) Allow flammable fluids or vapors to reach the heater in case of leakage.

(2) The region surrounding the heater, if the heater fuel system has fittings that, if they leaked, would allow fuel or vapors to enter this region.

(3) The part of the ventilating air passage that surrounds the combustion chamber. However, no fire extinguishment is required in cabin ventilating air passages.

(b) *Ventilating air ducts.* Each ventilating air duct passing through any fire zone must be fireproof. In addition—

(1) Unless isolation is provided by fireproof valves or by equally effective means, the ventilating air duct downstream of each heater must be fireproof for a distance great enough to ensure that any fire originating in the heater can be contained in the duct; and

(2) Each part of any ventilating duct passing through any region having a flammable fluid system must be constructed or isolated from that system so that the malfunctioning of any component of that system cannot introduce flammable fluids or vapors into the ventilating airstream.

(c) *Combustion air ducts.* Each combustion air duct must be fireproof for a distance great enough to prevent damage from backfiring or reverse flame propagation. In addition—

(1) No combustion air duct may have a common opening with the ventilating airstream unless flames from backfires or reverse burning cannot enter the ventilating airstream under any operating condition, including reverse flow or malfunctioning of the heater or its associated components; and

(2) No combustion air duct may restrict the prompt relief of any backfire that, if so restricted, could cause heater failure.

(d) *Heater controls; general.* Provision must be made to prevent the hazardous accumulation of water or ice on or in any heater control component, control system tubing, or safety control.

(e) *Heater safety controls.* For each combustion heater there must be the following safety control means:

(1) Means independent of the components provided for the normal continuous control of air temperature, airflow, and fuel flow must be provided, for each heater, to automatically shut off the ignition and fuel supply to that heater at a point remote from that heater when any of the following occurs:

(i) The heat exchanger temperature exceeds safe limits.

(ii) The ventilating air temperature exceeds safe limits.

(iii) The combustion airflow becomes inadequate for safe operation.

(iv) The ventilating airflow becomes inadequate for safe operation.

(2) The means of complying with subparagraph (1) of this paragraph for any individual heater must—

(i) Be independent of components serving any other heater whose heat output is essential for safe operation; and

(ii) Keep the heater off until restarted by the crew.

(3) There must be means to warn the crew when any heater whose heat output is es-

sential for safe operation has been shut off by the automatic means prescribed in subparagraph (1) of this paragraph.

(f) *Air intakes.* Each combustion and ventilating air intake must be located so that no flammable fluids or vapors can enter the heater system under any operating condition—

(1) During normal operation; or

(2) As a result of the malfunctioning of any other component.

(g) *Heater exhaust.* Heater exhaust systems must meet the provisions of §§ 25.1121 and 25.1123. In addition, there must be provisions in the design of the heater exhaust system to safely expel the products of combustion to prevent the occurrence of—

(1) Fuel leakage from the exhaust to surrounding compartments;

(2) Exhaust gas impingement on surrounding equipment or structure;

(3) Ignition of flammable fluids by the exhaust, if the exhaust is in a compartment containing flammable fluid lines; and

(4) Restriction by the exhaust of the prompt relief of backfires that, if so restricted, could cause heater failure.

(h) *Heater fuel systems.* Each heater fuel system must meet each powerplant fuel system requirement affecting safe heater operation. Each heater fuel system component within the ventilating airstream must be protected by shrouds so that no leakage from those components can enter the ventilating airstream.

(i) *Drains.* There must be means to safely drain fuel that might accumulate within the combustion chamber or the heat exchanger. In addition—

(1) Each part of any drain that operates at high temperatures must be protected in the same manner as heater exhausts; and

(2) Each drain must be protected from hazardous ice accumulation under any operating condition.

[§ 25.863 Flammable fluid fire protection.

[(a) In each area where flammable fluids or vapors might escape by leakage of a fluid system, there must be means to minimize the probability of ignition of the fluids and vapors, and the resultant hazards if ignition does occur.]

(b) Compliance with paragraph (a) of this section must be shown by analysis or tests, and the following factors must be considered:

(1) Possible sources and paths of fluid leakage, and means of detecting leakage.

(2) Flammability characteristics of fluids, including effects of any combustible or absorbing materials.

(3) Possible ignition sources, including electrical faults, overheating of equipment, and malfunctioning of protective devices.

(4) Means available for controlling or extinguishing a fire, such as stopping flow of fluids, shutting down equipment, fireproof containment, or use of extinguishing agents.

(5) Ability of airplane components that are critical to safety of flight to withstand fire and heat.

(c) If action by the flight crew is required to prevent or counteract a fluid fire (e.g. equipment shutdown or actuation of a fire extinguisher) quick acting means must be provided to alert the crew.

[(d) Each area where flammable fluids or vapors might escape by leakage of a fluid system must be identified and defined.]

§ 25.865 Fire protection of flight controls, engine mounts, and other flight structure.

Essential flight controls, engine mounts, and other flight structures located in designated fire zones or in adjacent areas which would be subjected to the effects of fire in the fire zone must be constructed of fireproof material or shielded so that they are capable of withstanding the effects of fire.

§ 25.867 Fire protection: other components.

(a) Surfaces to the rear of the nacelles, within one nacelle diameter of the nacelle centerline, must be at least fire-resistant.

(b) Paragraph (a) of this section does not apply to tail surfaces to the rear of the nacelles that could not be readily affected by heat, flames, or sparks coming from a designated fire zone or engine compartment of any nacelle.

MISCELLANEOUS

§ 25.871 Leveling means.

There must be means for determining when the airplane is in a level position on the ground.

§ 25.875 Reinforcement near propellers.

(a) Each part of the airplane near the propeller tips must be strong and stiff enough to withstand the effects of the induced vibration and of ice thrown from the propeller.

(b) No window may be near the propeller tips unless it can withstand the most severe ice impact likely to occur.

Subpart E—Powerplant

GENERAL

§ 25.901 Installation.

(a) For the purpose of this Part, the airplane powerplant installation includes each component that—

(1) Is necessary for propulsion;

(2) Affects the control of the major propulsive units; or

(3) Affects the safety of the major propulsive units between normal inspections or overhauls.

(b) For each powerplant—

(1) The installation must comply with—

(i) The installation instructions provided under § 33.5 of this chapter; and

(ii) The applicable provisions of this subpart;

(2) The components of the installation must be constructed, arranged, and installed so as to ensure their continued safe operation between normal inspections or overhauls;

(3) The installation must be accessible for necessary inspections and maintenance; and

(4) The major components of the installation must be electrically bonded to the other parts of the airplane.

(c) For each powerplant and auxiliary power unit installation, it must be established that no single failure or malfunction or probable combination of failures will jeopardize the safe operation of the airplane except that the failure of structural elements need not be considered if the probability of such failure is extremely remote.

(d) Each auxiliary power unit installation must meet the applicable provisions of this subpart.

[§ 25.903 Engines.

[(a) *Engine type certificate.*

[(1) Each engine must have a type certificate.

[(2) Each turbine engine must either—

[(i) Comply with § 33.77 of this chapter in effect on October 31, 1974, or as subsequently amended; or

[(ii) Be shown to have a foreign object ingestion service history in similar installation locations which has not resulted in any unsafe condition.]

(b) *Engine isolation.* The powerplants must be arranged and isolated from each other to allow operation, in at least one configuration, so that the failure or malfunction of any engine, or of any system that can affect the engine, will not—

(1) Prevent the continued safe operation of the remaining engines; or

(2) Require immediate action by any crewmember for continued safe operation.

(c) *Control of engine rotation.* There must be means for stopping the rotation of any engine individually in flight, except that, for turbine engine installations, the means for stopping the rotation of any engine need be provided only where continued rotation could jeopardize the safety of the airplane. Each component of the stopping system on the engine side of the firewall that might be exposed to fire must be at least fire-resistant. If hydraulic propeller feathering systems are used for this purpose, the feathering lines must be at least fire-resistant under the operating conditions that may be expected to exist during feathering.

(d) *Turbine engine installations.* For turbine engine installations—

(1) Design precautions must be taken to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire

originating within the engine which burns through the engine case.

(2) The powerplant systems associated with engine control devices, systems, and instrumentation, must be designed to give reasonable assurance that those engine operating limitations that adversely affect turbine rotor structural integrity will not be exceeded in service.

(e) *Restart capability.* (1) Means to restart any engine in flight must be provided.

(2) An altitude and airspeed envelope must be established for in-flight engine restarting, and each engine must have a restart capability within that envelope.

(3) For turbine engine powered airplanes, if the minimum windmilling speed of the engines, following the in-flight shutdown of all engines, is insufficient to provide the necessary electrical power for engine ignition, a power source independent of the engine-driven electrical power generating system must be provided to permit in-flight engine ignition for restarting.

[§ 25.904 Automatic takeoff thrust control system (ATTCS).

Each applicant seeking approval for installation of an engine power control system that automatically resets the power or thrust on the operating engine(s) when any engine fails during the takeoff must comply with the requirements of Appendix I.]

§ 25.905 Propellers.

(a) Each propeller must have a type certificate.

(b) Engine power and propeller shaft rotational speed may not exceed the limits for which the propeller is certificated.

(c) Each component of the propeller blade pitch control system must meet the requirements of § 35.42 of this chapter.

§ 25.907 Propeller vibration.

(a) The magnitude of the propeller blade vibration stresses under any normal condition of operation must be determined by actual measurement or by comparison with similar installations for which these measurements have been made.

(b) The determined vibration stresses may not exceed values that have been shown to be safe for continuous operation.

§ 25.925 Propeller clearance.

Unless smaller clearances are substantiated, propeller clearances with the airplane at maximum weight, with the most adverse center of gravity, and with the propeller in the most adverse pitch position, may not be less than the following:

(a) *Ground clearance.* There must be a clearance of at least seven inches (for each airplane with nose wheel landing gear) or nine inches (for each airplane with tail wheel landing gear) between each propeller and the ground with landing gear statically deflected and in the level takeoff, or taxiing attitude, whichever is most critical. In addition, there must be positive clearance between the propeller and the ground when in the level takeoff attitude with the critical tire completely deflated and the corresponding landing gear strut bottomed.

(b) *Water clearance.* There must be a clearance of at least 18 inches between each propeller and the water, unless compliance with § 25.239(a) can be shown with a lesser clearance.

(c) *Structural clearancer.* There must be—

(1) At least one inch radial clearance between the blade tips and the airplane structure, plus any additional radial clearance necessary to prevent harmful vibration;

(2) At least one-half inch longitudinal clearance between the propeller blades or cuffs and stationary parts of the airplane; and

(3) Positive clearance between other rotating parts of the propeller or spinner and stationary parts of the airplane.

§ 25.929 Propeller deicing.

(a) For airplanes intended for use where icing may be expected, there must be a means to prevent or remove hazardous ice accumulation on propellers or on accessories where ice accumulation would jeopardize engine performance.

(b) If combustible fluid is used for propeller deicing, §§ 25.1181 through 25.1185 and 25.1189 apply.

§ 25.933 Reversing systems.

(a) Each engine reversing system intended for ground operation only must be designed so that during any reversal in flight the engine will produce no more that flight idle thrust. In addition, it must be shown by analysis or test, or both, that—

(1) The reverser can be restored to the forward thrust position; or

(2) The airplane is capable of continued safe flight and landing under any possible position of the thrust reverser.

(b) Turbojet reversing systems intended for inflight use must be designed so that no unsafe condition will result during normal operation of the system, or from any failure (or reasonably likely combination of failures) of the reversing system, under any anticipated condition of operation of the airplane including ground operation. Failure of structural elements need not be considered if the probability of this kind of failure is extremely remote.

(c) Compliance with this section may be shown by failure analysis, testing, or both, for propeller systems that allow propeller blades to move from the flight low-pitch position to a position that is substantially less than that at the normal flight low-pitch stop position. The analysis may include or be supported by the analysis made to show compliance with the requirements of § 35.21 for the propeller and associated installation components.

(d) Each turbojet reversing system must have means to prevent the engine from producing more than idle forward thrust when the reversing system malfunctions, except that it may produce any greater forward thrust that is shown to allow directional control to be maintained, with aerodynamic means alone, under the most critical reversing condition expected in operation.

§ 25.934 Turbojet engine thrust reverser system tests.

Thrust reversers installed on turbojet engines must meet the requirements of § 33.97 of this Chapter.

§ 25.937 Turbopropeller-drag limiting systems.

Turbopropeller powered airplane propeller-drag limiting systems must be designed so that no single failure or malfunction of any the systems during normal or emergency operation results in propeller drag in excess of that for which the airplane was designed under § 25.-367. Failure of structural elements of the drag limiting systems need not be considered if the probability of this kind of failure is extremely remote.

§ 25.939 Turbine engine operating characteristics.

(a) Turbine engine operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operation within the range of operating limitations of the airplane and of the engine.

[(b) [Reserved]]

(c) The turbine engine air inlet system may not, as a result of air flow distortion during normal operation, cause vibration harmful to the engine.

§ 25.941 Inlet, engine, and exhaust compatibility.

For airplanes using variable inlet or exhaust system geometry, or both—

(a) The system comprised of the inlet, engine (including thrust augmentation systems, if incorporated), and exhaust must be shown to function properly under all operating conditions for which approval is sought, including all engine rotating speeds and power settings, and engine inlet and exhaust configurations;

(b) The dynamic effects of the operation of these (including consideration of probable malfunctions) upon the areodynamic control of the airplane may not result in any condition that would require exceptional skill, alertness, or strength on the part of the pilot to avoid exceeding an operational or structural limitation of the airplane; and

(c) In showing compliance with paragraph (b) of this section, the pilot strength required may not exceed the limits set forth in § 25.143 (c), subject to the conditions set forth in paragraphs (d) and (e) of § 25.143.

[§ 25.943 Negative acceleration.

[No hazardous malfunction of an engine, an auxiliary power unit approved for use in flight, or any component or system associated with the powerplant or auxiliary power unit may occur when the airplane is operated at the negative accelerations within the flight envelopes prescribed in § 25.333. This must be shown for the greatest duration expected for the acceleration.

[§ 25.945 Thrust or power augmentation system.

[(a) *General.* Each fluid injection system must provide a flow of fluid at the rate and pressure established for proper engine functioning under each intended operating condition. If the fluid can freeze, fluid freezing may not damage the airplane or adversely affect airplane performance.

[(b) *Fluid tanks.* Each augmentation system fluid tank must meet the following requirements:

[(1) Each tank must be able to withstand without failure the vibration, inertia, fluid, and structural loads that it may be subjected to in operation.

[(2) The tanks as mounted in the airplane must be able to withstand without failure or leakage an internal pressure 1.5 times the maximum operating pressure.

[(3) If a vent is provided, the venting must be effective under all normal flight conditions.

[(4) Each tank filler cap opening must be marked to identify the fluid at or near the filler cover.

[(c) Augmentation system drains must be designed and located in accordance with § 25.1455 if—

[(1) The augmentation system fluid is subject to freezing; and

[(2) The fluid may be drained in flight or during ground operation.

[(d) The augmentation liquid tank capacity available for the use of each engine must be large enough to allow operation of the airplane under the approved procedures for the use of liquid-augmented power. The computation of liquid consumption must be based on the maximum approved rate appropriate for the desired engine output and must include the effect of temperature on engine performance as well as any other factors that might vary the amount of liquid required.

[(e) This section does not apply to fuel injection systems.]

FUEL SYSTEM

§ 25.951 General.

(a) Each fuel system must be constructed and arranged to ensure a flow of fuel at a rate and pressure established for proper engine and auxiliary power unit functioning under each likely operating condition, including any maneuver for which certification is requested and during which the engine or auxiliary power unit is permitted to be in operation.

(b) Each fuel system must be arranged so that any air which is introduced into the system will not result in—

(1) Power interruption for more than 20 seconds for reciprocating engines; or

(2) Flameout for turbine engines.

(c) Each fuel system for a turbine engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80°F and having 0.75cc of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.

[§ 25.952 Fuel system analysis and test.

[(a) Proper fuel system functioning under all probable operating conditions must be shown by analysis and those tests found necessary by the Administrator. Tests, if required, must be made using the airplane fuel system or a test article that reproduces the operating characteristics of the portion of the fuel system to be tested.

[(b) The likely failure of any heat exchanger using fuel as one of its fluids may not result in a hazardous condition.]

§ 25.953 Fuel system independence.

Each fuel system must meet the requirements of § 25.903(b) by—

(a) Allowing the supply of fuel to each engine through a system independent of each part of the system supplying fuel to any other engine; or

(b) Any other acceptable method.

§ 25.954 Fuel system lightning protection.

The fuel system must be designed and arranged to prevent the ignition of fuel vapor within the system by—

(a) Direct lightning strikes to areas having a high probability of stroke attachment;

(b) Swept lightning strokes to areas where swept strokes are highly probable; and

(c) Corona and streamering at fuel vent outlets.

§ 25.955 Fuel flow.

(a) Each fuel system must provide at least 100 percent of the fuel flow required under each intended operating condition and maneuver. Compliance must be shown as follows:

(1) Fuel must be delivered to each engine at a pressure within the limits specified in the engine type certificate.

(2) The quantity of fuel in the tank may not exceed the amount established as the unusable fuel supply for that tank under the requirements of § 25.959 plus that necessary to show compliance with this section.

(3) Each main pump must be used that is necessary for each operating condition and attitude for which compliance with this section is shown, and the appropriate emergency pump must be substituted for each main pump so used.

(4) If there is a fuel flowmeter, it must be blocked and the fuel must flow through the meter or its bypass.

(b) If an engine can be supplied with fuel from more than one tank, the fuel system must—

(1) For each reciprocating engine, supply the full fuel pressure to that engine in not more than 20 seconds after switching to any other fuel tank containing usable fuel when engine malfunctioning becomes apparent due to the depletion of the fuel supply in any tank from which the engine can be fed; and

(2) For each turbine engine, in addition to having appropriate manual switching capability, be designed to prevent interruption of fuel flow to that engine, without attention by the flight crew, when any tank supplying fuel to that engine is depleted of usable fuel during normal operation, and any other tank, that normally supplies fuel to that engine alone, contains usable fuel.

§ 25.957 Flow between interconnected tanks.

If fuel can be pumped from one tank to another in flight, the fuel tank vents and the fuel transfer system must be designed so that no structural damage to the tanks can occur because of overfilling.

§ 25.959 Unusable fuel supply.

The unusable fuel quantity for each fuel tank and its fuel system components must be established at not less than the quantity at which the first evidence of engine malfunction occurs under the most adverse fuel feed condition for all intended operations and flight maneuvers involving fuel feeding from that tank. [Fuel system component failures need not be considered.]

§ 25.961 Fuel system hot weather operation.

(a) The fuel system must perform satisfactorily in hot weather operation. This must be shown by showing that the fuel system from the tank outlets to each engine is pressurized, under all intended operations, so as to prevent vapor formation, or must be shown by climbing from the altitude of the airport elected by the applicant to the maximum altitude established as an operating limitation under § 25.1527. If a climb test is elected, there may be no evidence of vapor lock or other malfunctioning during the climb test conducted under the following conditions:

(1) For reciprocating engine powered airplanes, the engines must operate at maximum continuous power, except that takeoff power must be used for the altitudes from 1,000 feet below the critical altitude through the critical altitude. The time interval during which takeoff power is used may not be less than the takeoff time limitation.

(2) For turbine engine powered airplanes, the engines must operate at takeoff power for the time interval selected for showing the takeoff flight path, and at maximum continuous power for the rest of the climb.

(3) The weight of the airplane must be the weight with full fuel tanks, minimum crew, and the ballast necessary to maintain the center of gravity within allowable limits.

[(i) For reciprocating engine powered airplanes, the maximum airspeed established for climbing from takeoff to the maximum operating altitude with the airplane in the following configuration:

[(A) Landing gear retracted.

[(B) Wing flaps in the most favorable position.

[(C) Cowl flaps (or other means of controlling the engine cooling supply) in the position that provides adequate cooling in the hot-day condition.

[(D) Engine operating within the maximum continuous power limitations.

[(E) Maximum takeoff weight; and]

(ii) For turbine engine powered airplanes, the maximum airspeed established for climbing from takeoff to the maximum operating altitude.

(5) The fuel temperature must be a least 110°F.

(b) The test prescribed in paragraph (a) of this section may be performed in flight or on the ground under closely simulated flight conditions. If a flight test is performed in weather cold enough to interfere with the proper conduct of the test, the fuel tank surfaces, fuel lines, and other fuel system parts subject to cold air must be insulated to simulate, insofar as practicable, flight in hot weather.

§ 25.963 Fuel tanks: general.

(a) Each fuel tank must be able to withstand, without failure, the vibration, inertia, fluid, and structural loads that it may be subjected to in operation.

(b) Flexible fuel tank liners must be approved or must be shown to be suitable for the particular application.

(c) Integral fuel tanks must have facilities for interior inspection and repair.

(d) Fuel tanks within the fuselage contour must be able to resist rupture, and to retain fuel, under the inertia forces prescribed for the emergency landing conditions in § 25.561. In addition, these tanks must be in a protected position so that exposure of the tanks to scraping action with the ground is unlikely.

(e) [Reserved]

(f) For pressurized fuel tanks, a means with fail-safe features must be provided to prevent the buildup of an excessive pressure difference between the inside and the outside of the tank.

§ 25.965 Fuel tank tests.

(a) It must be shown by tests that the fuel tanks, as mounted in the airplane can withstand, without failure or leakage, the more critical of the pressures resulting from the conditions specified in subparagraphs (1) and (2) of this paragraph. In addition, it must be shown by either analysis or tests, that tank surfaces subjected to more critical pressures resulting from the condition of subparagraphs (3) and (4) of this paragraph, are able to withstand the following pressures:

(1) An internal pressure of 3.5 p.s.i.

(2) 125 percent of the maximum air pressure developed in the tank from ram effect.

(3) Fluid pressures developed during maximum limit accelerations, and deflections, of the airplane with a full tank.

(4) Fluid pressures developed during the most adverse combination of airplane roll and fuel load.

(b) Each metallic tank with large unsupported or unstiffened flat surfaces, whose failure or deformation could cause fuel leakage, must be able to withstand the following test, or its equivalent, without leakage or excessive deformation of the tank walls:

(1) Each complete tank assembly and its supports must be vibration tested while mounted to simulate the actual installation.

(2) Except as specified in subparagraph (4) of this paragraph, the tank assembly must be vibrated for 25 hours at an amplitude of not less than $\frac{1}{32}$ of an inch (unless another amplitude is substantiated) while $\frac{2}{3}$ filled with water or other suitable test fluid.

(3) The test frequency of vibration must be as follows:

(i) If no frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, the test frequency of vibration must be 2,000 cycles per minute.

(ii) If only one frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, that frequency of vibration must be the test frequency.

(iii) If more than one frequency of vibration resulting from any r.p.m. within the normal operating range of engine speeds is critical, the most critical of these frequencies must be the test frequency.

(4) Under subparagraph (3) (ii) and (iii) of this paragraph, the time of test must be adjusted to accomplish the same number of vibration cycles that would be accomplished in 25 hours at the frequency specified in subparagraph (3) (i) of this paragraph.

(5) During the test, the tank assembly must be rocked at the rate of 16 to 20 complete cycles per minute, through an angle of 15° on both sides of the horizontal (30° total), about the most critical axis, for 25 hours. If motion about more than one axis is likely to be critical, the tank must be rocked about each critical axis for 12½ hours.

(c) Except where satisfactory operating experience with a similar tank in a similar installation is shown, nonmetallic tanks must withstand the test specified in paragraph (b) (5) of this section, with fuel at a temperature of 110°F. During this test, a representative specimen of the tank must be installed in a supporting structure simulating the installation in the airplane.

(d) For pressurized fuel tanks, it must be shown by analysis or tests that the fuel tanks can withstand the maximum pressure likely to occur on the ground or in flight.

§ 25.967 Fuel tank installations.

(a) Each fuel tank must be supported so that tank loads (resulting from the weight of the fuel in the tanks) are not concentrated on unsupported tank surfaces. In addition—

(1) There must be pads, if necessary, to prevent chafing between the tank and its supports;

(2) Padding must be nonabsorbent or treated to prevent the absorption of fluids;

(3) If a flexible tank liner is used, it must be supported so that it is not required to withstand fluid loads; and

(4) Each interior surface of the tank compartment must be smooth and free of projections that could cause wear of the liner unless—

(i) Provisions are made for protection of the liner at these points; or

(ii) The construction of the liner itself provides that protection.

(b) Spaces adjacent to tank surfaces must be ventilated to avoid fume accumulation due to minor leakage. If the tank is in a sealed compartment, ventilation may be limited to drain holes large enough to prevent excessive pressure resulting from altitude changes.

(c) The location of each tank must meet the requirements of § 25.1185(a).

(d) No engine nacelle skin immediately behind a major air outlet from the engine compartment may act as the wall of an integral tank.

(e) Each fuel tank must be isolated from personnel compartments by a fumeproof and fuelproof enclosure.

§ 25.969 Fuel tank expansion space.

Each fuel tank must have an expansion space of not less than 2 percent of the tank capacity. It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude. For pressure fueling systems, compliance with this section may be shown with the means provided to comply with § 25.979(b).

§ 25.971 Fuel tank sump.

(a) Each fuel tank must have a sump with an effective capacity, in the normal ground attitude, of not less than the greater of 0.10 percent of the tank capacity or one-sixteenth of a gallon unless operating limitations are established to ensure that the accumulation of water in service will not exceed the sump capacity.

(b) Each fuel tank must allow drainage of any hazardous quantity of water from any part of the tank to its sump with the airplane in the ground attitude.

(c) Each fuel tank sump must have an accessible drain that—

(1) Allows complete drainage of the sump on the ground;

(2) Discharges clear of each part of the airplane; and

(3) Has manual or automatic means for positive locking in the closed position.

§ 25.973 Fuel tank filler connection.

Each fuel tank filler connection must prevent the entrance of fuel into any part of the airplane other than the tank itself. In addition—

(a) Each filler must be marked as prescribed in § 25.1557(c);

[(b) Each recessed filler connection that can retain any appreciable quantity of fuel must have a drain that discharges clear of each part of the airplane;

[(c) Each filler cap must provide a fuel-tight seal; and

[(d) Each fuel filling point, except pressure fueling connection points, must have a provision for electrically bonding the airplane to ground fueling equipment.]

§ 25.975 Fuel tank vents and carburetor vapor vents.

(a) *Fuel tank vents.* Each fuel tank must be vented from the top part of the expansion space so that venting is effective under any normal flight condition. In addition—

(1) Each vent must be arranged to avoid stoppage by dirt or ice formation;

(2) The vent arrangement must prevent siphoning of fuel during normal operation;

(3) The venting capacity and vent pressure levels must maintain acceptable differences of pressure between the interior and exterior of the tank, during—

(i) Normal flight operation;

(ii) Maximum rate of ascent and descent; and

(iii) Refueling and defueling (where applicable);

(4) Airspaces of tanks with interconnected outlets must be interconnected;

(5) There may be no point in any vent line where moisture can accumulate with the airplane in the ground attitude or the level flight attitude, unless drainage is provided; and

(6) No vent or drainage provision may end at any point—

(i) Where the discharge of fuel from the vent outlet would constitute a fire hazard; or

(ii) From which fumes could enter personnel compartments.

(b) *Carburetor vapor vents.* Each carburetor with vapor elimination connections must have a vent line to lead vapors back to one of the fuel tanks. In addition—

(1) Each vent system must have means to avoid stoppage by ice; and

(2) If there is more than one fuel tank, and it is necessary to use the tanks in a definite sequence, each vapor vent return line must lead back to the fuel tank used for takeoff and landing.

§ 25.977 Fuel tank outlet.

(a) There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must—

(1) For reciprocating engine powered airplanes, have 8 to 16 meshes per inch; and

(2) For turbine engine powered airplanes, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

(b) [Reserved]

(c) The clear area of each fuel tank outlet strainer must be at least five times the area of the outlet line.

(d) The diameter of each strainer must be at least that of the fuel tank outlet.

(e) Each finger strainer must be accessible for inspection and cleaning.

§ 25.979 Pressure fueling system.

For pressure fueling systems, the following apply:

(a) Each pressure fueling system fuel manifold connection must have means to prevent the escape of hazardous quantities of fuel from the system if the fuel entry valve fails.

(b) An automatic shutoff means must be provided to prevent the quantity of fuel in each tank from exceeding the maximum quantity approved for that tank. This means must—

(1) Allow checking for proper shutoff operation before each fueling of the tank; and

(2) Provide indication, at each fueling station, of failure of the shutoff means to stop fuel flow at the desired level.

(c) A means must be provided to prevent damage to the fuel system in the event of failure of the automatic shutoff means prescribed in paragraph (b) of this section.

(d) The airplane pressure fueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum pressures, including surge, that is likely to occur during fueling. The maximum surge pressure must be established with any combination of tank valves being either intentionally or inadvertently closed.

(e) The airplane defueling system (not including fuel tanks and fuel tank vents) must withstand an ultimate load that is 2.0 times the load arising from the maximum permissible defueling pressure (positive or negative) at the airplane fueling connection.

§ 25.981 Fuel tank temperature.

(a) The highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the fuel tanks must be determined.

(b) No temperature at any place inside any fuel tank where fuel ignition is possible may exceed the temperature determined under paragraph (a) of this section. This must be shown under all probable operating, failure, and malfunction conditions of any component whose operation, failure, or malfunction could increase the temperature inside the tank.

FUEL SYSTEM COMPONENTS

§ 25.991 Fuel pumps.

(a) *Main pumps.* Each fuel pump required for proper engine operation, or required to meet the fuel system requirements of this subpart (other than those in paragraph (b) of this section), is a main pump. For each main pump, provision must be made to allow the bypass of each positive displacement fuel pump other than a fuel injection pump (a pump that supplies the proper flow and pressure for fuel injection when the injection is not accomplished in a carburetor) approved as part of the engine.

(b) *Emergency pumps.* There must be emergency pumps or another main pump to feed each engine immediately after failure of any main pump (other than a fuel injection pump approved as part of the engine).

§ 25.993 Fuel system lines and fittings.

(a) Each fuel line must be installed and supported to prevent excessive vibration and to withstand loads due to fuel pressure and accelerated flight conditions.

(b) Each fuel line connected to components of the airplane between which relative motion could exist must have provisions for flexibility.

(c) Each flexible connection in fuel lines that may be under pressure and subjected to axial loading must use flexible hose assemblies.

(d) Flexible hose must be approved or must be shown to be suitable for the particular application.

(e) No flexible hose that might be adversely affected by exposure to high temperatures may be used where excessive temperatures will exist during operation or after engine shutdown.

(f) Each fuel line within the fuselage must be designed and installed to allow a reasonable degree of deformation and stretching without leakage.

[§ 25.994 Fuel system components.

[Fuel system components in an engine nacelle or in the fuselage must be protected from damage which could result in spillage of enough fuel to constitute a fire hazard as a result of a wheels-up landing on a paved runway.]

§ 25.995 Fuel valves.

In addition to the requirements of § 25.1189 for shutoff means, each fuel valve must—

(a) [Reserved]

(b) Be supported so that no loads resulting from their operation or from accelerated flight conditions are transmitted to the lines attached to the valve.

§ 25.997 Fuel strainer or filter.

There must be a fuel strainer or filter between the fuel tank outlet and the inlet of either the fuel metering device or an engine driven positive displacement pump, whichever is nearer the fuel tank outlet. This fuel strainer or filter must—

(a) Be accessible for draining and cleaning and must incorporate a screen or element which is easily removable;

(b) Have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes;

[(c) Be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter itself, unless adequate strength margins under all loading conditions are provided in the lines and connections; and

[(d) Have the capacity (with respect to operating limitations established for the engine) to ensure that engine fuel system functioning is not impaired, with the fuel contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine in Part 33 of this chapter.]

§ 25.999 Fuel system drains.

(a) Drainage of the fuel system must be accomplished by the use of fuel strainer and fuel tank sump drains.

(b) Each drain required by paragraph (a) of this section must—

(1) Discharge clear of all parts of the airplane:

(2) Have manual or automatic means for positive locking in the closed position; and

(3) Have a drain valve—

(i) That is readily accessible and which can be easily opened and closed; and

(ii) That is either located or protected to prevent fuel spillage in the event of a landing with landing gear retracted.

[§ 25.1001 Fuel jettisoning system.

[(a) A fuel jettisoning system must be installed on each airplane unless it is shown that the airplane meets the climb requirements of § 25.119 and § 25.121(d) at maximum takeoff weight, less the actual or computed weight of fuel necessary for a 15-minute flight comprised of a takeoff, go-around, and landing at the airport of departure with the airplane configuration, speed, power, and thrust the same as that used in meeting the applicable takeoff, approach, and landing climb performance requirements of this Part.

[(b) If a fuel jettisoning system is required it must be capable of jettisoning enough fuel within 15 minutes, starting with the weight given in paragraph (a) of this section, to enable the airplane to meet the climb requirements of §§ 25.119 and 25.121(d), assuming that the fuel is jettisoned under the conditions, except weight, found least favorable during the flight tests prescribed in paragraph (c) of this section.

[(c) Fuel jettisoning must be demonstrated beginning at maximum takeoff weight with flaps and landing gear up and in—

[(1) A power-off glide at $1.4V_{S_1}$;

[(2) A climb at the one-engine inoperative best rate-of-climb speed, with the critical engine inoperative and the remaining engines at maximum continuous power; and

[(3) Level flight at $1.4V_{S_1}$ if the results of the tests in the conditions specified in paragraphs (c) (1) and (2) of this section show that this condition could be critical.

[(d) During the flight tests prescribed in paragraph (c) of this section, it must be shown that—

[(1) The fuel jettisoning system and its operation are free from fire hazard;

[(2) The fuel discharges clear of any part of the airplane;

[(3) Fuel or fumes do not enter any parts of the airplane; and

[(4) The jettisoning operation does not adversely affect the controllability of the airplane.]

[(e)] For reciprocating engine powered airplanes, means must be provided to prevent jettisoning the fuel in the tanks used for takeoff and landing below the level allowing 45 minutes flight at 75 percent maximum continuous power. However, if there is an auxiliary control independent of the main jettisoning control, the system may be designed to jettison the remaining fuel by means of the auxiliary jettisoning control.

[(f)] For turbine engine powered airplanes, means must be provided to prevent jettisoning the fuel in the tanks used for takeoff and landing below the level allowing climb from sea level to 10,000 feet and thereafter allowing 45 minutes cruise at a speed for maximum range. However, if there is an auxiliary control independent of the main jettisoning control, the system may be designed to jettison the remaining fuel by means of the auxiliary jettisoning control.

[(g)] The fuel jettisoning valve must be designed to allow flight personnel to close the valve during any part of the jettisoning operation.

[(h)] Unless it is shown that using any means (including flaps, slots, and slats) for changing the airflow across or around the wings does not adversely affect fuel jettisoning, there must be a placard, adjacent to the jettisoning control, to warn flight crewmembers against jettisoning fuel while the means that change the airflow are being used.

[(i)] The fuel jettisoning system must be designed so that any reasonably probable single malfunction in the system will not result in a hazardous condition due to unsymmetrical jettisoning of, or inability to jettison, fuel.

OIL SYSTEM

§ 25.1011 General.

(a) Each engine must have an independent oil system that can supply it with an appropriate quantity of oil at a temperature not above that safe for continuous operation.

(b) The usable oil capacity may not be less than the product of the endurance of the airplane under critical operating conditions and the approved maximum allowable oil consumption of the engine under the same conditions, plus a suitable margin to ensure system circulation. Instead of a rational analysis of airplane range for the purpose of computing oil requirements for reciprocating engine powered airplanes, the following fuel/oil ratios may be used:

(1) For airplanes without a reserve oil or oil transfer system, a fuel/oil ration of 30:1 by volume.

(2) For airplanes with either a reserve oil or oil transfer system, a fuel/oil ratio of 40:1 by volume.

(c) Fuel/oil ratios higher than those prescribed in paragraphs (b) (1) and (2) of this section may be used if substantiated by data on actual engine oil consumption.

§ 25.1013 Oil tanks.

(a) *Installation.* Each oil tank installation must meet the requirements of § 25.967. For a reciprocating engine having an integral oil sump of less than [25-quart] capacity, the oil sump need not be fireproof.

(b) *Expansion space.* Oil tank expansion space must be provided as follows:

(1) Each oil tank used with a reciprocating engine must have an expansion space of not less than the greater of 10 percent of the tank capacity or 0.5 gallon, and each oil tank used with a turbine engine must have an expansion space of not less than 10 percent of the tank capacity.

(2) Each reserve oil tank not directly connected to any engine may have an expansion space of not less than two percent of the tank capacity.

(3) It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.

(c) *Filler connection.* Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have a drain that discharges clear of each part of the airplane. In addition—

(1) Each oil tank filler cap must provide an oil-tight seal; and

(2) Each oil filler must be marked under § 25.1557(b) (2).

(d) *Vent.* Oil tanks must be vented as follows:

(1) Each oil tank must be vented from the top part of the expansion space so that venting is effective under any normal flight condition.

(2) Oil tanks vents must be arranged so that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.

(e) *Outlet.* There must be means to prevent entrance into the tank itself, or into the tank outlet, of any object that might obstruct the flow of oil through the system. No oil tank outlet may be enclosed by any screen or guard that would reduce the flow of oil below a safe value at any operating temperature. There must be a shutoff valve at the outlet of each oil tank used with a turbine engine, unless the external portion of the oil system (including the oil tank supports) is fireproof.

(f) *Flexible oil tank liners.* Each flexible oii tank liner must be approved or must be shown to be suitable for the particular aplication.

§ 25.1015 Oil tank tests.

Each oil tank must be designed and installed so that—

(a) It can withstand, without failure, each vibration, inertia, and fluid load that it may be subjected to in operation; and

(b) It meets the provisions of § 25.965, except—

(1) The test pressure—

(i) For pressurized tanks used with a turbine engine, may not be less than 5 p.s.i. plus the maximum operating pressure of the tank instead of the pressure specified in § 25.965(a); and

(ii) For all other tanks may not be less than 5 p.s.i. instead of the pressure specified in § 25.965(a); and

(2) The test fluid must be oil at 250°F. instead of the fluid specified in § 25.965(c).

§ 25.1017 Oil lines and fittings.

(a) Each oil line must meet the requirements of § 25.993 and each oil line and fitting in any designated fire zone must meet the requirements of § 25.1183.

(b) Breather lines must be arranged so that—

(1) Condensed water vapor that might freeze and obstruct the line cannot accumulate at any point;

(2) The breather discharge does not constitute a fire hazard if foaming occurs or causes emitted oil to strike the pilot's windshield; and

(3) The breather does not discharge into the engine air induction system.

§ 25.1019 Oil strainer or filter.

(a) Each turbine engine installation must incorporate an oil strainer of filter through which all of the engine oil flows and which meets the following requirements:

(1) Each oil strainer or filter that has a bypass, must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter completely blocked.

[(2) The oil strainer or filter must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired when the oil is contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine under Part 33 of this chapter.

[(3) The oil strainer or filter, unless it is installed at an oil tank outlet, must incorporate an indicator that will indicate contamination before it reaches the capacity established in accordance with subparagraph (2) of this paragraph.]

(4) The bypass of a strainer or filter must be constructed and installed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.

(5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in § 25.1305(c) (7).

(b) Each oil strainer or filter in a powerplant installation using reciprocating engines must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

[§ 25.1021 Oil system drains.

[A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must—

[(a) Be accessible; and

[(b) Have manual or automatic means for positive locking in the closed position.]

§ 25.1023 Oil radiators.

(a) Each oil radiator must be able to withstand, without failure, any vibration, inertia, and oil pressure load to which it would be subjected in operation.

(b) Each oil radiator air duct must be located so that, in case of fire, flames coming from normal openings of the engine nacelle cannot impinge directly upon the radiator.

§ 25.1025 Oil valves.

(a) Each oil shutoff must meet the requirements of § 25.1189.

(b) The closing of oil shutoff means may not prevent propeller feathering.

(c) Each oil valve must have positive stops or suitable index provisions in the "on" and "off" positions and must be supported so that no loads resulting from its operation or from accelerated flight conditions are transmitted to the lines attached to the valve.

§ 25.1027 Propeller feathering system.

(a) If the propeller feathering system depends on engine oil, there must be means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other than the tank itself.

(b) The amount of trapped oil must be enough to accomplish the feathering operation and must be available only to the feathering pump.

(c) The ability of the system to accomplish feathering with the trapped oil must be shown. This may be done on the ground using an auxiliary source of oil for lubricating the engine during operation.

(d) Provision must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.

COOLING

§ 25.1041. General.

The powerplant and auxiliary power unit cooling provisions must be able to maintain the temperatures of powerplant components, engine fluids, and auxiliary power unit components and fluids within the temperature limits established for these components and fluids, under ground, water, and flight operating conditions, and after normal engine or auxiliary power unit shutdown, or both.

§ 25.1043 Cooling tests.

(a) *General.* Compliance with § 25.1041 must be shown by tests, under critical ground, water, and flight operating conditions. For these tests, the following apply:

(1) If the tests are conducted under conditions deviating from the maximum ambient atmospheric temperature, the recorded powerplant temperatures must be corrected under paragraphs (c) and (d) of this section.

(2) No corrected temperatures determined under subparagraph (1) of this paragraph may exceed established limits.

(3) For reciprocating engines, the fuel used during the cooling tests must be the minimum grade approved for the engines, and the mixture settings must be those normally used in the flight stages for which the cooling tests are conducted. The test procedures must be as prescribed in § 25.1045.

(b) *Maximum ambient atmospheric temperature.* A maximum ambient atmospheric temperature corresponding to sea level conditions of at least 100 degrees F must be established. The assumed temperature lapse rate is 3.6 degrees F per thousand feet of altitude above sea level until a temperature of −69.7 degrees F is reached, above which altitude the temperature is considered constant at −69.7 degrees F. However, for winterization installations, the applicant may select a maximum ambient atmospheric temperature corresponding to sea level conditions of less than 100 degrees F.

(c) *Correction factor (except cylinder barrels).* Unless a more rational correction applies, temperatures of engine fluids and powerplant components (except cylinder barrels) for which temperature limits are established, must be corrected by adding to them the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum component or fluid temperature recorded during the cooling test.

(d) *Correction factor for cylinder barrel temperatures.* Unless a more rational correction applies, cylinder barrel temperatures must be corrected by adding to them 0.7 times the difference between the maximum ambient atmospheric temperature and the temperature of the ambient air at the time of the first occurrence of the maximum cylinder barrel temperature recorded during the cooling test.

§ 25.1045 Cooling test procedures.

(a) Compliance with § 25.1041 must be shown for the takeoff, climb, en route, and landing stages of flight that correspond to the applicable performance requirements. The cooling tests must be conducted with the airplane in the configuration, and operating under the conditions, that are critical relative to cooling during each stage of flight. For the cooling tests, a temperature is "stabilized" when its rate of change is less than 2° F. per minute.

(b) Temperatures must be stabilized under the conditions from which entry is made into each stage of flight being investigated, unless the entry condition normally is not one during which component and engine fluid temperatures would stabilize (in which case, operation through the full entry condition must be conducted before entry into the stage of flight being investigated in order to allow temperatures to reach their natural levels at the time of entry). The takeoff cooling test must be preceded by a period during which the powerplant component and engine fluid temperatures are stabilized with the engines at ground idle.

(c) Cooling tests for each stage of flight must be continued until—

(1) The component and engine fluid temperatures stabilize;

(2) The stage of flight is completed; or

(3) An operating limitation is reached.

(d) For reciprocating engine powered airplanes, it may be assumed, for cooling test purposes, that the takeoff stage of flight is complete when the airplane reaches an altitude of 1,500 feet above the takeoff surface or reaches a point in the takeoff where the transition from the takeoff to the en route configuration is completed and a speed is reached at which compliance with [§ 25.121(c)] is shown, whichever point is at a higher altitude.[The airplane must be in the following configuration:

[(1) Landing gear retracted.

[(2) Wing flaps in the most favorable position.

[(3) Cowl flaps (or other means of controlling the engine cooling supply) in the position that provides adequate cooling in the hot-day condition.

[(4) Critical engine inoperative and its propeller stopped.

[(5) Remaining engines at the maximum continuous power available for the altitude.]

(e) For hull seaplanes and amphibians, cooling must be shown during taxiing downwind for 10 minutes, at 5 knots above step speed.

INDUCTION SYSTEM

§ 25.1091 Air induction.

(a) The air induction system for each engine and auxiliary power unit must supply—

(1) The air required by that engine and auxiliary power unit under each operating condition for which certification is requested; and

(2) The air for proper fuel metering and mixture distribution with the induction system valves in any position.

(b) Each reciprocating engine must have an alternative air source that prevents the entry of rain, ice, or any other foreign matter.

(c) Air intakes may not open within the cowling, unless—

(1) That part of the cowling is isolated from the engine accessory section by means of a fireproof diaphragm; or

(2) For reciprocating engines, there are means to prevent the emergence of backfire flames.

(d) For turbine engine powered airplanes and airplanes incorporating auxiliary power units—

(1) There must be means to prevent hazardous quantities of fuel leakage or overflow from drains, vents, or other components of flammable fluid systems from entering the engine or auxiliary power unit intake system; and

(2) The airplane must be designed to prevent water or slush on the runway, taxiway, or other airport operating surfaces from being directed into the engine or auxiliary power unit air inlet ducts in hazardous quantities, and the air inlet ducts must be located or protected so as to minimize the ingestion of foreign matter during takeoff, landing, and taxiing.

[(e) If the engine induction system contains parts or components that could be damaged by foreign objects entering the air inlet, it must be shown by tests or, if appropriate, by analysis that the induction system design can withstand the foreign object ingestion test conditions of § 33.77 of this chapter without failure of parts or components that could create a hazard.]

§ 25.1093 [Induction system icing protection.]

(a) *Reciprocating engines.* Each reciprocating engine air induction system must have means to prevent and eliminate icing. Unless this is done by other means, it must be shown that, in air free of visible moisture at a temperature of 30°F., each airplane with altitude engines using—

(1) Conventional venturi carburetors has a preheater that can provide a heat rise of 120°F. with the engine at 60 percent of maximum continuous power; or

(2) Carburetors tending to reduce the probability of ice formation has a preheater that can provide a heat rise of 100°F. with the engine at 60 percent of maximum continuous power.

(b) *Turbine engines.* (1) Each turbine engine and its air inlet system must operate throughout the flight power range of the engine (including idling), within the limitations established for the airplane, without the accumulation of ice on engine or inlet system components that would adversely affect engine operation or cause a serious loss of power or thrust—

(i) Under the icing conditions specified in Appendix C; and

(ii) In snow, both falling and blowing.

[(2) Each turbine engine must idle for 30 minutes on the ground, with the air bleed available for engine icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between 15° and 30°F. (between -9° and -1°C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by a momentary operation at takeoff power or thrust. During the 30 minutes of idle operation, the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.]

(c) *Supercharged reciprocating engines.* For each engine having a supercharger to pressurize the air before it enters the carburetor, the heat rise in the air caused by that supercharging at any altitude may be utilized in determining compliance with paragraph (a) of this section if the heat rise utilized is that which will be available, automatically, for the applicable altitude and operating condition because of supercharging.

§ 25.1101 Carburetor air pressure design.

Each carburetor air preheater must be designed and constructed to—

(a) Ensure ventilation of the preheater when the engine is operated in cold air;

(b) Allow inspection of the exhaust manifold parts that it surrounds; and

(c) Allow inspection of critical parts of the preheater itself.

§ 25.1103 Induction system ducts and air duct systems.

(a) Each induction system duct upstream of the first stage of the engine supercharger and of the auxiliary power unit compressor must have a drain to prevent the hazardous accumulation of fuel and moisture in the ground attitude. No drain may discharge where it might cause a fire hazard.

(b) Each induction system duct must be—

(1) Strong enough to prevent induction system failures resulting from normal backfire conditions; and

(2) Fire resistant if it is in any fire zone for which a fire-extinguishing system is required, except that ducts for auxiliary power units must be fireproof within the auxiliary power unit fire zone.

(c) Each duct connected to components between which relative motion could exist must have means for flexibility.

(d) For turbine engine and auxiliary power unit bleed air duct systems, no hazard may result if a duct failure occurs at any point between the air duct source and the airplane unit served by the air.

(e) Each auxiliary power unit induction system duct must be fireproof for a sufficient distance upstream of the auxiliary power unit compartment to prevent hot gas reverse flow from burning through auxiliary power unit ducts and entering any other compartment or area of the airplane in which a hazard would be created resulting from the entry of hot gases. The materials used to form the remainder of the induction system duct and plenum chamber of the auxiliary power unit must be capable of resisting the maximum heat conditions likely to ocur.

(f) Each auxiliary power unit induction system duct must be constructed of materials that will not absorb or trap hazardous quantities of flammable fluids that could be ignited in the event of a surge or reverse flow condition.

§ 25.1105 Induction system screens.

If induction system screens are used—

(a) Each screen must be upstream of the carburetor;

(b) No screen may be in any part of the induction system that is the only passage through which air can reach the engine, unless it can be deiced by heated air;

(c) No screen may be deiced by alcohol alone; and

(d) It must be impossible for fuel to strike any screen.

§ 25.1107 Inter-coolers and after-coolers.

Each inter-cooler and after-cooler must be able to withstand any vibration, inertia, and air pressure load to which it would be subjected in operation.

EXHAUST SYSTEM

§ 25.1121 General.

For powerplant and auxiliary power unit installations the following apply:

(a) Each exhaust system must ensure safe disposal of exhaust gases without fire hazard or carbon monoxide contamination in any personnel compartment. For test purposes, any acceptable carbon monoxide detection method may be used to show the absence of carbon monoxide.

(b) Each exhaust system part with a surface hot enough to ignite flammable fluids or vapors must be located or shielded so that leakage from any system carrying flammable fluids or vapors will not result in a fire caused by impingement of the fluids or vapors on any part of the exhaust system including shields for the exhaust system.

(c) Each component that hot exhaust gases could strike, or that could be subjected to high temperatures from exhaust system parts, must be fireproof. All exhaust system components must be separated by fireproof shields from adjacent parts of the airplane that are outside the engine and auxiliary power unit compartments.

(d) No exhaust gases may discharge so as to cause a fire hazard with respect to any flammable fluid vent or drain.

(e) No exhaust gases may discharge where they will cause a glare seriously affecting pilot vision at night.

(f) Each exhaust system component must be ventilated to prevent points of excessively high temperature.

(g) Each exhaust shroud must be ventilated or insulated to avoid, during normal operation, a temperature high enough to ignite any flammable fluids or vapors external to the shroud.

§ 25.1123 Exhaust piping.

For powerplant and auxiliary power unit installations, the following apply:

(a) Exhaust piping must be heat and corrosion resistant, and must have provisions to prevent failure due to expansion by operating temperatures.

(b) Piping must be supported to withstand any vibration and inertia loads to which it would be subjected in operation; and

(c) Piping connected to components between which relative motion could exist must have means for flexibility.

§ 25.1125 Exhaust heat exchangers.

For reciprocating engine powered airplanes, the following apply:

(a) Each exhaust heat exchanger must be constructed and installed to withstand each vibration, inertia, and other load to which it would be subjected in operation. In addition—

(1) Each exchanger must be suitable for continued operation at high temperatures and resistant to corrosion from exhaust gases;

(2) There must be means for the inspection of the critical parts of each exchanger;

(3) Each exchanger must have cooling provisions wherever it is subject to contact with exhaust gases; and

(4) No exhaust heat exchanger or muff may have any stagnant areas or liquid traps that would increase the probability of ignition of flammable fluids or vapors that might be present in case of the failure or malfunction of components carrying flammable fluids.

(b) If an exhaust heat exchanger is used for heating ventilating air—

(1) There must be a secondary heat exchanger between the primary exhaust gas heat exchanger and the ventilating air system; or

(2) Other means must be used to preclude the harmful contamination of the ventilating air.

§ 25.1127 Exhaust driven turbo-superchargers.

(a) Each exhaust driven turbo-supercharger must be approved or shown to be suitable for the particular application. It must be installed and supported to ensure safe operation between normal inspections and overhauls. In addition, there must be provisions for expansion and flexibility between exhaust conduits and the turbine.

(b) There must be provisions for lubricating the turbine and for cooling turbine parts where temperatures are critical.

(c) If the normal turbo-supercharger control system malfunctions, the turbine speed may not exceed its maximum allowable value. Except for the waste gate operating components, the components provided for meeting this requirement must be independent of the normal turbo-supercharger controls.

POWERPLANT CONTROLS AND ACCESSORIES

§ 25.1141 Powerplant controls: general.

Each powerplant control must be located, arranged, and designed under §§ 25.777 through 25.781 and marked under § 25.1555. In addition, it must meet the following requirements:

(a) Each control must be located so that it cannot be inadvertently operated by persons entering, leaving, or moving normally in, the cockpit.

(b) Each flexible control must be approved or must be shown to be suitable for the particular application.

(c) Each control must have sufficient strength and rigidity to withstand operating loads without failure and without excessive deflection.

(d) Each control must be able to maintain any set position without constant attention by flight crewmembers and without creep due to control loads or vibration.

(e) [Reserved]

(f) Powerplant valve controls located in the cockpit must have—

(1) For manual valves, positive stops or in the case of fuel valves suitable index provisons, in the open and closed position; and

(2) For power-assisted valves, a means to indicate to the flight crew when the valve—

(i) Is in the fully open or fully closed position; or

(ii) Is moving between the fully open and fully closed position.

§ 25.1142 Auxiliary power unit controls.

Means must be provided on the flight deck for starting, stopping, and emergency shutdown of each installed auxiliary power unit.

§ 25.1143 Engine controls.

(a) There must be a separate power or thrust control for each engine.

(b) Power and thrust controls must be arranged to allow—

(1) Separate control of each engine; and

(2) Simultaneous control of all engines.

(c) Each power and thrust control must provide a positive and immediately responsive means of controlling its engine.

[(d) For each fluid injection (other than fuel) system and its controls not provided and approved as part of the engine, the applicant must show that the flow of the injection fluid is adequately controlled.]

(e) If a power or thrust control incorporates a fuel shutoff feature, the control must have a means to prevent the inadvertent movement of the control into the shutoff position. The means must—

(1) Have a positive lock or stop at the idle position; and

(2) Require a separate and distinct operation to place the control in the shutoff position.

§ 25.1145 Ignition switches.

(a) Ignition switches must control each engine ignition circuit on each engine.

(b) There must be means to quickly shut off all ignition by the grouping of switches or by a master ignition control.

(c) Each group of ignition switches, except ignition switches for turbine engines for which continuous ignition is not required, and each master ignition control must have a means to prevent its inadvertent operation.

§ 25.1147 Mixture controls.

(a) If there are mixture controls, each engine must have a separate control. The controls must be grouped and arranged to allow—

(1) Separate control of each engine; and

(2) Simultaneous control of all engines.

(b) Each intermediate position of the mixture controls that corresponds to a normal operating setting must be identifiable by feel and sight.

(c) The mixture controls must be accessible to both pilots. However, if there is a separate flight engineer station with a control panel, the controls need be accessible only to the flight engineer.

§ 25.1149 Propeller speed and pitch controls.

(a) There must be a separate propeller speed and pitch control for each propeller.

(b) The controls must be grouped and arranged to allow—

(1) Separate control of each propeller; and

(2) Simultaneous control of all propellers.

(c) The controls must allow synchronization of all propellers.

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(d) The propeller speed and pitch controls must be to the right of, and at least one inch below, the pilot's throttle controls.

§ 25.1153 Propeller feathering controls.

(a) There must be a separate propeller feathering control for each propeller. The control must have means to prevent its inadvertent operation.

(b) If feathering is accomplished by movement of the propeller pitch or speed control lever, there must be means to prevent the inadvertent movement of this lever to the feathering position during normal operation.

§ 25.1155 Reverse thrust and propeller pitch settings below the flight regime.

Each control for reverse thrust and for propeller pitch settings below the flight regime must have means to prevent its inadvertent operation. The means must have a positive lock or stop at the flight idle position and must require a separate and distinct operation by the crew to displace the control from the flight regime (forward thrust engine regime for turbojet powered airplanes).

§ 25.1157 Carburetor air temperature controls.

There must be a separate carburetor air temperature control for each engine.

§ 25.1159 Supercharger controls.

Each supercharger control must be accessible to the pilots or, if there is a separate flight engineer station with a control panel, to the flight engineer.

§ 25.1161 Fuel jettisoning system controls.

Each fuel jettisoning system control must have guards to prevent inadvertent operation. No control may be near any fire extinguisher control or other control used to combat fire.

[§ 25.1163 Powerplant accessories.

[(a) Each engine-mounted accessory must—

[(1) Be approved for mounting on the engine involved;

[(2) Use the provisions on the engine for mounting; and

[(3) Be sealed to prevent contamination of the engine oil system and the accessory system.]

(b) Electrical equipment subject to arcing or sparking must be installed to minimize the probability of contact with any flammable fluids or vapors that might be present in a free state.

(c) If continued rotation of an engine-driven cabin supercharger or of any remote accessory driven by the engine is hazardous if malfunctioning occurs, there must be means to prevent rotation without interfering with the continued operation of the engine.

§ 25.1165 Engine ignition systems.

(a) Each battery ignition system must be supplemented by a generator that is automatically available as an alternate source of electrical energy to allow continued engine operation if any battery becomes depleted.

(b) The capacity of batteries and generators must be large enough to meet the simultaneous demands of the engine ignition system and the greatest demands of any electrical system components that draw electrical energy from the same source.

(c) The design of the engine ignition system must account for—

(1) The condition of an inoperative generator;

(2) The condition of a completely depleted battery with the generator running at its normal operating speed; and

(3) The condition of a completely depleted battery with the generator operating at idling speed, if there is only one battery.

(d) Magneto ground wiring (for separate ignition circuits) that lies on the engine side of the fire wall, must be installed, located, or protected, to minimize the probability of simultaneous failure of two or more wires as a result of mechanical damage, electrical faults, or other cause.

(e) No ground wire for any engine may be routed through a fire zone of another engine unless each part of that wire within that zone is fireproof.

(f) Each ignition system must be independent of any electrical circuit not used for assisting, controlling, or analyzing the operation of that system.

(g) There must be means to warn appropriate flight crewmembers if the malfunctioning of any part of the electrical system is causing the continuous discharge of any battery necessary for engine ignition.

§ 25.1167 Accessory gearboxes.

For airplanes equipped with an accessory gearbox that is not certificated as part of an engine—

(a) The engine with gearbox and connecting transmissions and shafts attached must be subjected to the tests specified in §§ 33.49 or 33.87 of this chapter as applicable;

(b) The accessory gearbox must meet the requirements of §§ 33.25 and 33.53 or 33.91 of this chapter, as applicable; and

(c) Possible misalignments and torsional loadings of the gearbox, transmission, and shaft system, expected to result under normal operating conditions must be evaluated.

POWERPLANT FIRE PROTECTION

§ 25.1181 Designated fire zones: regions included.

(a) Designated fire zones are—

(1) The engine power section;

(2) The engine accessory section;

(3) Except for reciprocating engines, any complete powerplant compartment in which no isolation is provided between the engine power section and the engine accessory section;

(4) Any auxiliary power unit compartment;

(5) Any fuel-burning heater and other combustion equipment installation described in § 25.859;

(6) The compressor and accessory sections of turbine engines; and

(7) Combustor, turbine, and tailpipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases.

(b) Each designated fire zone must meet the requirements of §§ 25.1185 through 25.1205.

§ 25.1182 Nacelle areas behind firewalls, and engine pad attaching structures containing flammable fluid lines.

(a) Each nacelle area immediately behind the firewall, and each portion of any engine pod attaching structure containing flammable fluid lines, must meet each requirement of §§ 25.1103(b), 25.1165(d) and (e), 25.1183, 25.1185(c), 25.1187, 25.1189, and 25.1195 through 25.1203, including those concerning designated fire zones. However, engine pod attaching structures need not contain fire detection or extinguishing means.

(b) For each area covered by paragraph (a) of this section that contains a retractable landing gear, compliance with that paragraph need only be shown with the landing gear retracted.

§ 25.1183 Flammable fluid-carrying components.

(a) Except as provided in paragraph (b) of this section, each line, fitting, and other component carrying flammable fluid in any area subject to engine fire conditions, and each component which conveys or contains flammable fluid in a designated fire zone must be fire resistant, except that flammable fluid tanks and supports in a designated fire zone must be fireproof or be enclosed by a fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. Components must be shielded or located to safeguard against the ignition of leaking flammable fluid. An integral oil sump of less than [25-quart] capacity on a reciprocating engine need not be fireproof nor be enclosed by a fireproof shield.

(b) Paragraph (a) of this section does not apply to—

[(1) Lines, fittings, and components which are already approved as part of a type certificated engine; and]

(2) Vent and drain lines, and their fittings, whose failure will not result in, or add to, a fire hazard.

§ 25.1185 Flammable fluids.

(a) Except for the integral oil sumps specified in § 25.1013(a), no tank or reservoir that is a part of a system containing flammable fluids or gases may be in a designated fire zone unless the fluid contained, the design of the system, the materials used in the tank, the shut-off means, and all connections, lines, and control provide a degree of safety equal to that which would exist if the tank or reservoir were outside such a zone.

(b) There must be at least one-half inch of clear airspace between each tank or reservoir and each firewall or shroud isolating a designated fire zone.

(c) Absorbent materials close to flammable fluid system components that might leak must be covered or treated to prevent the absorption of hazardous quantities of fluids.

§ 25.1187 Drainage and ventilation of fire zones.

(a) There must be complete drainage of each part of each designated fire zone to minimize the hazards resulting from failure or malfunctioning of any component containing flammable fluids. The drainage means must be—

(1) Effective under conditions expected to prevail when drainage is needed; and

(2) Arranged so that no discharged fluid will cause an additional fire hazard.

(b) Each designated fire zone must be ventilated to prevent the accumulation of flammable vapors.

(c) No ventilation opening may be where it would allow the entry of flammable fluids, vapors, or flame from other zones.

(d) Each ventilation means must be arranged so that no discharged vapors will cause an additional fire hazard.

(e) Unless the extinguishing agent capacity and rate of discharge are based on maximum air flow through a zone, there must be means to allow the crew to shut off sources of forced ventilation to any fire zone except the engine power section of the nacelle and the combustion heater ventilating air ducts.

§ 25.1189 Shutoff means.

(a) Each engine [installation] and each fire zone specified in § 25.1181(a)(4) and (5) must have a means to shut off or otherwise prevent hazardous quantities of fuel, oil, deicer, and other flammable fluids, from flowing into, within, or through any designated fire zone, except that shutoff means are not required for—

[(1) Lines, fittings, and components forming an integral part of an engine; and

[(2) Oil systems for turbine engine installations in which all components of the system in a designated fire zone, including the oil tanks, are fireproof or located in areas not subject to engine fire conditions.]

(b) The closing of any fuel shutoff valve for any engine may not make fuel unavailable to the remaining engines.

(c) Operation of any shutoff may not interfere with the later emergency operation of other equipment, such as the means for feathering the propeller.

(d) Each flammable fluid shutoff means and control must be fireproof or must be located and protected so that any fire in a fire zone will not affect its operation.

(e) No hazardous quantity of flammable fluid may drain into any designated fire zone after shutoff.

(f) There must be means to guard against inadvertent operation of the shutoff means and to make it possible for the crew to reopen the shutoff means in flight after it has been closed.

(g) Each tank-to-engine shutoff valve must be located so that the operation of the valve will not be affected by powerplant or engine mount structural failure.

(h) Each shutoff valve must have a means to relieve excessive pressure accumulation unless a means for pressure relief is otherwise provided in the system.

§ 25.1191 Firewalls.

(a) Each engine, auxiliary power unit, fuel-burning heater, other combustion equipment intended for operation in flight, and the combustion, turbine, and tailpipe sections of turbine engines, must be isolated from the rest of the airplane by firewalls, shrouds, or equivalent means.

(b) Each firewall and shroud must be—

(1) Fireproof;

(2) Constructed so that no hazardous quantity of air, fluid, or flame can pass from the compartment to other parts of the airplane;

(3) Constructed so that each opening is sealed with close fitting fireproof grommets, bushings, or firewall fittings; and

(4) Protected against corrosion.

§ 25.1192 Engine accessory section diaphragm.

For reciprocating engines, the engine power section and all portions of the exhaust system must be isolated from the engine accessory compartment by a diaphragm that complies with the firewall requirements of § 25.1191.

§ 25.1193 Cowling and nacelle skin.

(a) Each cowling must be constructed and supported so that it can resist any vibration, inertia, and air load to which it may be subjected in operation.

(b) Cowling must meet the drainage and ventilation requirements of § 25.1187.

(c) On airplanes with a diaphragm isolating the engine power section from the engine accessory section, each part of the accessory section cowling subject to flame in case of fire in the engine power section of the powerplant must—

(1) Be fireproof; and

(2) Meet the requirements of § 25.1191.

(d) Each part of the cowling subject to high temperatures due to its nearness to exhaust system parts or exhaust gas impingement must be fireproof.

(e) Each airplane must—

(1) Be designed and constructed so that no fire originating in any fire zone can enter, either through openings or by burning through external skin, any other zone or region where it would create additional hazards;

(2) Meet subparagraph (1) of this paragraph with the landing gear retracted (if applicable); and

(3) Have fireproof skin in areas subject to flame if a fire starts in the engine power or accessory sections.

§ 25.1195 Fire extinguishing systems.

(a) Except for combustor, turbine, and tail pipe sections of turbine engine installations that contain lines or components carrying flammable fluids or gases for which it is shown that a fire originating in these sections can be controlled, there must be a fire extinguisher system serving each designated fire zone.

[(b) The fire extinguishing system, the quantity of the extinguishing agent, the rate of discharge, and the discharge distribution must be adequate to extinguish fires. It must be shown by either actual or simulated flight tests that under critical airflow conditions in flight the discharge of the extinguishing agent in each designated fire zone specified in paragraph (a) of this section will provide an agent concentration capable of extinguishing fires in that zone and of minimizing the probability of reignition. An individual "one-shot" system may be used for auxiliary power units, fuel burning heaters, and other combustion equipment. For each other designated fire zone, two discharges must be provided each of which produces adequate agent concentration.]

(c) The fire-extinguishing system for a nacelle must be able to simultaneously protect each zone of the nacelle for which protection is provided.

§ 25.1197 Fire extinguishing agents.

(a) Fire extinguishing agents must—

(1) Be capable of extinguishing flames emanating from any burning of fluids or other combustible materials in the area protected by the fire extinguishing system; and

(2) Have thermal stability over the temperature range likely to be experience in the compartment in which they are stored.

(b) If any toxic extinguishing agent is used, provisions must be made to prevent harmful concentrations of fluid or fluid vapors (from leakage during normal operation of the airplane or as a result of discharging the fire extinguisher on the ground or in flight) from entering any personnel compartment, even though a defect may exist in the extinguishing system. This must be shown by test except for built-in carbon dioxide fuselage compartment fire extinguishing systems for which—

(1) Five pounds or less of carbon dioxide will be discharged, under established fire control procedures, into any fuselage compartment; or

(2) There is protective breathing equipment for each flight crewmember on flight deck duty.

[(c) [Deleted]]

§ 25.1199 Extinguishing agent containers.

(a) Each extinguishing agent container must have a pressure relief to prevent bursting of the container by excessive internal pressures.

[(b) The discharge end of each discharge line from a pressure relief connection must be located so that discharge of the fire extinguishing agent would not damage the airplane. The line must also be located or protected to prevent clogging caused by ice or other foreign matter.

[(c) There must be a means for each fire extinguishing agent container to indicate that the container has discharged or that the charging pressure is below the established minimum necessary for proper functioning.]

(d) The temperature of each container must be maintained, under intended operating conditions, to prevent the pressure in the container from—

(1) Falling below that necessary to provide an adequate rate of discharge; or

(2) Rising high enough to cause premature discharge.

(e) If a pyrotechnic capsule is used to discharge the extinguishing agent, each container must be installed so that temperature conditions will not cause hazardous deterioration of the pyrotechnic capsule.

§ 25.1201 Fire extinguishing system materials.

(a) No material in any fire extinguishing system may react chemically with any extinguishing agent so as to create a hazard.

(b) Each system component in an engine compartment must be fireproof.

§ 25.1203 Fire-detector system.

(a) There must be approved, quick acting fire or overheat detectors in each designated fire zone, and in the combustion, turbine, and tailpipe sections of turbine engine installations, in numbers and locations ensuring prompt detection of fire in those zones.

(b) Each fire detector system must be constructed and installed so that—

(1) It will withstand the vibration, inertia, and other loads to which it may be subjected in operation;

(2) There is a means to warn the crew in the event that the sensor or associated wiring within a designated fire zone is severed at one point, unless the system continues to function as a satisfactory detection system after the severing; and

(3) There is a means to warn the crew in the event of a short circuit in the sensor or associated wiring within a designated fire zone, unless the system continues to function as a satisfactory detection system after the short circuit.

(c) No fire or overheat detector may be affected by any oil, water, other fluids, or fumes that might be present.

(d) There must be means to allow the crew to check, in flight, the functioning of each fire or overheat detector electric circuit.

(e) Wiring and other components of each fire or overheat detector system in a fire zone must be at least fire-resistant.

(f) No fire or overheat detector system component for any fire zone may pass through another fire zone, unless—

(1) It is protected against the possibility of false warnings resulting from fires in zones through which it passes; or

(2) Each zone involved is simultaneously protected by the same detector and extinguishing system.

(g) Each fire detector system must be constructed so that when it is in the configuration for installation it will not exceed the alarm activation time approved for the detectors using the response time criteria specified in the appropriate Technical Standard Order for the detector.

§ 25.1205 [Revoked.]

[§ 25.1207 Compliance.

[Unless otherwise specified, compliance with the requirements of §§ 25.1181 through 25.1203 must be shown by a full scale fire test or by one or more of the following methods:

[(a) Tests of similar powerplant configurations;

[(b) Tests of components;

[(c) Service experience of aircraft with similar powerplant configurations;

[(d) Analysis.]

Subpart F—Equipment

GENERAL

§ 25.1301 Function and installation.

Each item of installed equipment must—

(a) Be of a kind and design appropriate to its intended function;

(b) Be labeled as to its identification, function, or operating limitations, or any applicable combination of these factors;

(c) Be installed according to limitations specified for that equipment; and

(d) Function properly when installed.

§ 25.1303 Flight and navigation instruments.

(a) The following flight and navigation instruments must be installed so that the instrument is visible from each pilot station:

(1) A free air temperature indicator or an air-temperature indicator which provides indications that are convertible to free-air temperature.

(2) A clock displaying hours, minutes, and seconds with a sweep-second pointer or digital presentation.

(3) A direction indicator (nonstabilized magnetic compass).

(b) The following flight and navigation instruments must be installed at each pilot station:

(1) An airspeed indicator. If airspeed limitations vary with altitude, the indicator must have a maximum allowable airspeed indicator showing the variation of V_{MO} with altitude.

(2) An altimeter (sensitive).

(3) A rate-of-climb indicator (vertical speed).

(4) A gyroscopic rate-of-turn indicator combined with an integral slip-skid indicator (turn-and-bank indicator) except that only a slip-skid indicator is required on large airplanes with a third attitude instrument system useable through flight attitudes of 360° of pitch and roll and installed in accordance with § 121.305(j) of this title.

(5) A bank and pitch indicator (gyroscopically stabilized).

(6) A direction indicator (gyroscopically stabilized, magnetic or nonmagnetic).

(c) The following flight and navigation instruments are required as prescribed in this paragraph:

(1) A speed warning device is required for turbine engine powered airplanes and for airplanes with V_{MO}/M_{MO} greater than 0.8 V_{DF}/M_{DF} or 0.8 V_D/M_D. The speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots, whenever the speed exceeds V_{MO} plus 6 knots or $M_{MO}+0.01$. The upper limit of the production tolerance for the warning device may not exceed the prescribed warning speed.

(2) A machmeter is required at each pilot station for airplanes with compressibility limitations not otherwise indicated to the pilot by the airspeed indicating system required under paragraph (b)(1) of this section.

§ 25.1305 Powerplant instruments.

The following are required powerplant instruments:

(a) *For all airplanes.*

(1) A fuel pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(2) A fuel quantity indicator for each fuel tank.

(3) An oil quantity indicator for each oil tank.

(4) An oil pressure indicator for each independent pressure oil system of each engine.

(5) An oil pressure warning means for each engine, or a master warning means for all engines with provision for isolating the individual warning means from the master warning means.

(6) An oil temperature indicator for each engine.

(7) Fire-warning indicators.

(8) An augmentation liquid quantity indicator (appropriate for the manner in which the liquid is to be used in operation) for each tank.

(b) *For reciprocating engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) A carburetor air temperature indicator for each engine.

(2) A cylinder head temperature indicator for each air-cooled engine.

(3) A manifold pressure indicator for each engine.

(4) A fuel pressure indicator (to indicate the pressure at which the fuel is supplied) for each engine.

(5) A fuel flowmeter, or fuel mixture indicator, for each engine without an automatic altitude mixture control.

(6) A tachometer for each engine.

(7) A device that indicates, to the flight crew (during flight), any change in the power output, for each engine with—

(i) An automatic propeller feathering system, whose operation is initiated by a power output measuring system; or

(ii) A total engine piston displacement of 2,000 cubic inches or more.

(8) A means to indicate to the pilot when the propeller is in reverse pitch, for each reversing propeller.

(c) *For turbine engine-powered airplanes.* In addition to the powerplant instruments required by paragraph (a) of this section, the following powerplant instruments are required:

(1) A gas temperature indicator for each engine.

(2) A fuel flowmeter indicator for each engine.

(3) A tachometer (to indicate the speed of the rotors with established limiting speeds) for each engine.

(4) A means to indicate, to the flight crew, the operation of each engine starter that can be operated continuously but that is neither designed for continuous operation nor designed to prevent hazard if it failed.

(5) An indicator to indicate the functioning of the powerplant ice protection system for each engine.

(6) An indicator for the fuel strainer or filter required by § 25.997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with § 25.997(d).

(7) A warning means for the oil strainer or filter required by § 25.1019, if it has no bypass, to warn the pilot of the occurrence of contamination of the strainer or filter screen before it reaches the capacity established in accordance with § 25.1019(a) (2).

(8) An indicator to indicate the proper functioning of any heater used to prevent ice clogging of fuel system components.

(d) *For turbojet engine-powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required:

[(1) An indicator to indicate thrust, or a parameter that is directly related to thrust, to the pilot. The indication must be based on the direct measurement of thrust or of parameters that are directly related to thrust. The indicator must indicate a change in thrust resulting from any engine malfunction, damage, or deterioration.]

(2) A position indicating means to indicate to the flight crew when the thrust reversing device is in the reverse thrust position, for each engine using a thrust reversing device.

(3) An indicator to indicate rotor system unbalance.

(e) *For turbopropeller-powered airplanes.* In addition to the powerplant instruments required by paragraphs (a) and (c) of this section, the following powerplant instruments are required:

(1) A torque indicator for each engine.

(2) Position indicating means to indicate to the flight crew when the propeller blade angle is below the flight low pitch position, for each propeller.

(3) A means to indicate to the pilot when the propeller is in reverse pitch, for each reversing propeller.

(f) For airplanes equipped with fluid systems (other than fuel) for thrust or power augmentation, an approved means must be provided to indicate the proper functioning of that system to the flight crew.

§ 25.1307 Miscellaneous equipment.

The following is required miscellaneous equipment:

(a) A seat for each occupant.

(b) Two or more independent sources of electrical energy.

(c) Electrical protective devices, as prescribed in this Part.

(d) Two systems for two-way radio communications, with controls for each accessible from each pilot station, designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.

(e) Two systems for radio navigation, with controls for each accessible from each pilot station, designed and installed so that failure of one system will not preclude operation of the other system. The use of a common antenna system is acceptable if adequate reliability is shown.

(f) A windshield wiper, or equivalent, for each pilot station.

(g) An ignition switch, for each engine.

[(h) Portable fire extinguishers as prescribed in § 25.851(a)(5) and (a)(6).]

§ 25.1309 Equipment, systems, and installations.

(a) The equipment, systems, and installations whose functioning is required by this subchapter, must be designed to ensure that they perform their intended functions under any foreseeable operating condition.

(b) The airplane systems and associated components, considered separately and in relation to other systems, must be designed so that—

(1) The occurrence of any failure condition which would prevent the continued safe flight and landing of the airplane is extremely improbable, and

(2) The occurrence of any other failure condition which would reduce the capability of the airplane or the ability of the crew to cope with adverse operating conditions is improbable.

(c) Warning information must be provided to alert the crew to unsafe system operating conditions, and to enable them to take appropriate corrective action. Systems, controls, and associated monitoring and warning means must be designed to minimize crew errors which could create additional hazards.

(d) Compliance with the requirements of paragraph (b) of this section must be shown by analysis, and where necessary, by appropriate ground, flight, or simulator tests. The analysis must consider—

(1) Possible modes of failure, including malfunctions and damage from external sources.

(2) The probability of multiple failures and undetected failures.

(3) The resulting effects on the airplane and occupants, considering the stage of flight and operating conditions, and

(4) The crew warning cues, corrective action required, and the capability of detecting faults.

(e) Each installation whose functioning is required by this subchapter, and that requires a power supply, is an "essential load" on the power supply. The power sources and the system must be able to supply the following power loads in probable operating combinations and for probable durations:

(1) Loads connected to the system with the system functioning normally.

(2) Essential loads, after failure of any one prime mover, power converter, or energy storage device.

[(3) Essential loads after failure of—

[(i) Any one engine on two-engine airplanes; and

[(ii) Any two engines on three-or-more engine airplanes.**]**

(4) Essential loads for which an alternate source of power is required by this chapter, after any failure or malfunction in any one power supply system, distribution system, or other utilization system.

[(f) In determining compliance with paragraphs (e) (2) and (3) of this section, the power loads may be assumed to be reduced under a monitoring procedure consistent with safety in the kinds of operation authorized. Loads not required in controlled flight need not be considered for the two-engine-inoperative condition on airplanes with three or more engines.**]**

(g) In showing compliance with paragraphs (a) and (b) of this section with regard to the electrical system and equipment design and installation, critical environmental conditions must be considered. For electrical generation, distribution, and utilization equipment required by or used in complying with this chapter, except equipment covered by Technical Standard Orders containing environmental test procedures, the ability to provide continuous, safe service under foreseeable environmental conditions may be shown by environmental tests, design analysis, or reference to previous comparable service experience on other aircraft.

INSTRUMENTS: INSTALLATION

§ 25.1321 Arrangement and visibility.

(a) Each flight, navigation, and powerplant instrument for use by any pilot must be plainly visible to him from his station with the minimum practicable deviation from his normal position and line of vision when he is looking forward along the flight path.

(b) The flight instruments required by § 25.1303 must be grouped on the instrument panel and centered as nearly as practicable about the vertical plane of the pilot's forward vision. In addition—

(1) The instrument that most effectively indicates attitude must be on the panel in the top center position;

(2) The instrument that most effectively indicates airspeed must be adjacent to and directly to the left of the instrument in the top center position;

(3) The instrument that most effectively indicates altitude must be adjacent to and directly to the right of the instrument in the top center position; and

(4) The instrument that most effectively indicates direction of flight must be adjacent to and directly below the instrument in the top center position.

(c) Required powerplant instruments must be closely grouped on the instrument panel. In addition—

(1) The location of identical powerplant instruments for the engines must prevent confusion as to which engine each instrument relates; and

(2) Powerplant instruments vital to the safe operation of the airplane must be plainly visible to the appropriate crewmembers.

(d) Instrument panel vibration may not damage or impair the accuracy of any instrument.

[(e) If a visual indicator is provided to indicate malfunction of an instrument, it must be effective under all probable cockpit lighting conditions.**]**

§ 25.1322 Warning, caution, and advisory lights.

If warning, caution, or advisory lights are installed in the cockpit, they must, unless otherwise approved by the Administrator, be—

(a) Red, for warning lights (lights indicating a hazard which may require immediate corrective action);

(b) Amber, for caution lights (lights indicating the possible need for future corrective action);

(c) Green, for safe operation lights; and

(d) Any other color, including white, for lights not described in paragraphs (a) through (c) of this section, provided the color differs sufficiently from the colors prescribed in paragraphs (a) through (c) of this section to avoid possible confusion.

§ 25.1323 Airspeed indicating system.

For each airspeed indicating system, the following apply:

(a) Each airspeed indicating instrument must be approved and must be calibrated to indicate true airspeed (at sea level with a standard atmosphere) with a minimum practicable instrument calibration error when the corresponding pitot and static pressures are applied.

(b) Each system must be calibrated to determine the system error (that is, the relation between IAS and CAS) in flight and during the accelerated takeoff ground run. The ground run calibration must be determined—

(1) From 0.8 of the minimum value of V_1 to the maximum value of V_2, considering the approved ranges of altitude and weight; and

[(2) With the flaps and power settings corresponding to the values determined in the establishment of the takeoff path under § 25.111 assuming that the critical engine fails at the minimum value of V_1.]

(c) The airspeed error of the installation, excluding the airspeed indicator instrument calibration error, may not exceed three percent or five knots, whichever is greater, throughout the speed range, from—

(1) V_{MO} to 1.3 V_{S_1} with flaps retracted; and

(2) 1.3 V_{S_0} V_{FE} with flaps in the landing position.

(d) Each system must be arranged, so far as practicable, to prevent malfunction or serious error due to the entry of moisture, dirt, or other substances.

(e) Each system must have a heated pitot tube or an equivalent means of preventing malfunction due to icing.

(f) Where duplicate airspeed indicators are required, their respective pitot tubes must be far enough apart to avoid damage to both tubes in a collision with a bird.

§ 25.1325 Static pressure systems.

(a) Each instrument with static air case connections must be vented to the outside atmosphere through an appropriate piping system.

(b) Each static port must be designed and located in such manner that the static pressure system performance is least affected by airflow variation, or by moisture or other foreign matter, and that the correlation between air pressure in the static pressure system and true ambient atmospheric static pressure is not changed when the airplane is exposed to the continuous and intermittent maximum icing conditions defined in Appendix C of this Part.

(c) The design and installation of the static pressure system must be such that—

(1) Positive drainage of moisture is provided; chafing of the tubing and excessive distortion or restriction at bends in the tubing is avoided; and the materials used are durable, suitable for the purpose intended, and protected against corrosion; and

(2) It is airtight except for the port into the atmosphere. A proof test must be conducted to demonstrate the integrity of the static pressure system in the following manner:

(i) *Unpressurized airplanes.* Evacuate the static pressure system to a pressure differential of approximately 1 inch of mercury or to a reading on the altimeter, 1,000 feet above the airplane elevation at the time of the test. Without additional pumping for a period of 1 minute, the loss of indicated altitude must not exceed 100 feet on the altimeter.

(ii) *Pressurized airplanes.* Evacuate the static pressure system until a pressure differential equivalent to the maximum cabin pressure differential for which the airplane is type certificated is achieved. Without additional pumping for a period of 1 minute, the loss of indicated altitude must not exceed 2 percent of the equivalent altitude of the maximum cabin differential pressure or 100 feet, whichever is greater.

(d) Each pressure altimeter must be approved and must be calibrated to indicate pressure altitude in a standard atmosphere, with a minimum practicable calibration error when the corresponding static pressures are applied.

(e) Each system must be designed and installed so that the error in indicated pressure altitude, at sea level, with a standard atmosphere, excluding instrument calibration error, does not result in an error of more than ±30 feet per 100 knots speed for the appropriate configuration in the speed range between 1.3 V_{S_0} with flaps extended and 1.8 V_{S_1} with flaps retracted. However, the error need not be less than ±30 feet.

(f) If an altimeter system is fitted with a device that provides corrections to the altimeter indication, the device must be designed and installed in such manner that it can be bypassed when it malfunctions, unless an alternate altimeter system is provided. Each correction device must be fitted with a means for indicating the occurrence of reasonably probable malfunctions, including power failure, to the flight crew. The indicating means must be effective for any cockpit lighting condition likely to occur.

(g) Except as provided in paragraph (h) of this section, if the static pressure system incorporates both a primary and an alternate static pressure source, the means for selecting one or the other source must be designed so that—

(1) When either source is selected, the other is blocked off; and

(2) Both sources cannot be blocked off simultaneously.

(h) For unpressurized airplanes, paragraph (g)(1) of this section does not apply if it can be demonstrated that the static pressure system calibration, when either static pressure source is selected, is not changed by the other static pressure source being open or blocked.

§ 25.1326 Pitot heat indication systems.

If a flight instrument pitot heating system is installed, an indication system must be provided to indicate to the flight crew when that pitot heating system is not operating. The indication system must comply with the following requirements:

(a) The indication provided must incorporate an amber light that is in clear view of a flight crewmember.

(b) The indication provided must be designed to alert the flight crew if either of the following conditions exist:

(1) The pitot heating system is switched "off".

(2) The pitot heating system is switched "on" and any pitot tube heating element is inoperative.

§ 25.1327 Magnetic direction indicator.

(a) Each magnetic direction indicator must be installed so that its accuracy is not excessively affected by the airplane's vibration or magnetic fields.

(b) The compensated installation may not have a deviation, in level flight, greater than 10° on any heading.

§ 25.1329 Automatic pilot system.

(a) Each automatic pilot system must be approved and must be designed so that the automatic pilot can be quickly and positively disengaged by the pilots to prevent it from interfering with their control of the airplane.

(b) Unless there is automatic synchronization, each system must have a means to readily indicate to the pilot the alignment of the actuating device in relation to the control system it operates.

(c) Each manually operated control for the system must be readily accessible to the pilots.

(d) Quick release (emergency) controls must be on both control wheels, on the side of each wheel opposite the throttles.

(e) Attitude controls must operate in the plane and sense of motion specified in §§ 25.777 (b) and 25.779(a) for cockpit controls. The direction of motion must be plainly indicated on, or adjacent to, each control.

(f) The system must be designed and adjusted so that, within the range of adjustment available to the human pilot, it cannot produce hazardous loads on the airplane, or create hazardous deviations in the flight path, under any condition of flight appropriate to its use, either during normal operation, or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(g) If the automatic pilot integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be positive interlocks and sequencing of engagement to prevent improper operation. Protection against adverse interaction of integrated components, resulting from a malfunction, is also required.

[(h) If the automatic pilot system can be coupled to airborne navigation equipment, means must be provided to indicate to the flight crew the current mode of operation. Selector switch position is not acceptable as a means of indication.]

§ 25.1331 Instruments using a power supply.

(a) For each instrument required by § 25.1303(b) that uses a power supply, the following apply:

(1) Each instrument must have a visual means integral with the instrument, to indicate when power adequate to sustain proper instrument performance is not being supplied. The power must be measured at or near the point where it enters the instruments. For electric instruments, the power is considered to be adequate when the voltage is within approved limits.

(2) Each instrument must, in the event of the failure of one power source, be supplied by another power source. This may be accomplished automatically or by manual means.

(3) If an instrument presenting navigation data receives information from sources external to that instrument and loss of that information would render the presented data unreliable, the instrument must incorporate a visual means to warn the crew, when such loss of information occurs, that the presented data should not be relied upon.

(b) As used in this section, "instrument" includes devices that are physically contained in one unit, and devices that are composed of two or more physically separate units or components connected together (such as a remote indicating gyroscopic direction indicator that includes a magnetic sensing element, a gyroscopic unit, an amplifier, and an indicator connected together).

§ 25.1333 Instrument systems.

For systems that operate the instruments required by § 25.1303(b) which are located at each pilot's station—

(a) Means must be provided to connect the required instruments at the first pilot's station to operating systems which are independent of the operating systems at other flight crew stations, or other equipment;

(b) The equipment, systems, and installations must be designed so that one display of the information essential to the safety of flight which is provided by the instruments, including attitude, direction, airspeed, and altitude will remain available to the pilots, without additional crewmember action, after any single failure or combination of failures that is not shown to be extremely improbable; and

(c) Additional instruments, systems, or equipment may not be connected to the operating systems for the required instruments, unless provisions are made to ensure the continued normal functioning of the required instruments in the event of any malfuction of the additional instruments, systems, or equipment which is not shown to be extremely improbable.

§ 25.1335 Flight director systems.

If a flight director system is installed, means must be provided to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.

§ 25.1337 Powerplant instruments.

(a) *Instruments and instrument lines.*

(1) Each powerplant and auxiliary power unit instrument line must meet the requirements of §§ 25.993 and 25.1183.

(2) Each line carrying flammable fluids under pressure must—

(i) Have restricting orifices or other safety devices at the source of pressure to prevent the escape of excessive fluid if the line fails; and

(ii) Be installed and located so that the escape of fluids would not create a hazard.

(3) Each powerplant and auxiliary power unit instrument that utilizes flammable fluids must be installed and located so that the escape of fluid would not create a hazard.

(b) *Fuel quantity indicator.* There must be means to indicate to the flight crewmembers, the quantity, in gallons or equivalent units, of usable fuel in each tank during flight. In addition—

(1) Each fuel quantity indicator must be calibrated to read "zero" during level flight when the quantity of fuel remaining in the tank is equal to the unusable fuel supply determined under § 25.959;

(2) Tanks with interconnected outlets and airspaces may be treated as one tank and need not have separate indicators; and

(3) Each exposed sight gauge, used as a fuel quantity indicator, must be protected against damage.

(c) *Fuel flowmeter system.* If a fuel flowmeter system is installed, each metering component must have a means for bypassing the fuel supply if malfunction of that component severely restricts fuel flow.

(d) *Oil quantity indicator.* There must be a stick gauge or equivalent means to indicate the quantity of oil in each tank. If an oil transfer or reserve oil supply system is installed, there must be a means to indicate to the flight crew, in flight, the quantity of oil in each tank.

(e) *Turbopropeller blade position indicator.* Required turbopropeller blade position indicators must begin indicating before the blade moves more than eight degrees below the flight low pitch stop. The source of indication must directly sense the blade position.

(f) *Fuel pressure indicator.* There must be means to measure fuel pressure, in each system supplying reciprocating engines, at a point downstream of any fuel pump except fuel injection pumps. In addition—

(1) If necessary for the maintenance of proper fuel delivery pressure, there must be a connection to transmit the carburetor air intake static pressure to the proper pump relief valve connection; and

(2) If a connection is required under subparagraph (1) of this paragraph, the gauge balance lines must be independently connected to the carburetor inlet pressure to avoid erroneous readings.

ELECTRICAL SYSTEMS AND EQUIPMENT

§ 25.1351 General.

(a) *Electrical system capacity.* The required generating capacity, and number and kinds of power sources must—

(1) Be determined by an electrical load analysis; and

(2) Meet the requirements of § 25.1309.

(b) *Generating system.* The generating system includes electrical power sources, main power busses, transmission cables, and associated control, regulation, and protective devices. It must be designed so that—

(1) Power sources function properly when independent and when connected in combination;

(2) No failure or malfunction of any power source can create a hazard or impair the ability of remaining sources to supply essential loads;

(3) The system voltage and frequency (as applicable) at the terminals of all essential load equipment can be maintained within

the limits for which the equipment is designed, during any probable operating condition: and

(4) System transients due to switching, fault clearing, or other causes do not make essential loads inoperative, and do not cause a smoke or fire hazard.

(5) There are means accessible, in flight, to appropriate crewmembers for the individual and collective disconnection of the electrical power sources from the system.

(6) There are means to indicate to appropriate crewmembers the generating system quantities essential for the safe operation of the system, such as the voltage and current supplied by each generator.

(c) *External power.* If provisions are made for connecting external power to the airplane, and that external power can be electrically connected to equipment other than that used for engine starting, means must be provided to ensure that no external power supply having a reverse polarity, or a reverse phase sequence, can supply power to the airplane's electrical system.

(d) *Operation without normal electrical power.* It must be shown by analysis, tests, or both, that the airplane can be operated safely in VFR conditions, for a period of not less than five minutes, with the normal electrical power (electrical power sources excluding the battery) inoperative, with critical type fuel (from the standpoint of flameout and restart capability), and with the airplane initially at the maximum certificated altitude. Parts of the electrical system may remain on if—

(1) A single malfunction, including a wire bundle or junction box fire, cannot result in loss of the part turned off and the part turned on;

(2) The parts turned on are electrically and mechanically isolated from the parts turned off; and

(3) The electrical wire and cable insulation, and other materials, of the parts turned on are self-extinguishing when tested in accordance with § 25.1359(d).

§ 25.1353 Electrical equipment and installations.

(a) Electrical equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to the safe operation.

(b) Cables must be grouped, routed, and spaced so that damage to essential circuits will be minimized if there are faults in heavy current-carrying cables.

(c) Storage batteries must be designed and installed as follows:

(1) Safe cell temperatures and pressures must be maintained during any probable charging or discharging condition. No uncontrolled increase in cell temperature may result when the battery is recharged (after previous complete discharge)—

(i) At maximum regulated voltage or power;

(ii) During a flight of maximum duration; and

(iii) Under the most adverse cooling condition likely to occur in service.

(2) Compliance with subparagraph (1) of this paragraph must be shown by test unless experience with similar batteries and installations has shown that maintaining safe cell temperatures and pressures presents no problem.

(3) No explosive or toxic gases emitted by any battery in normal operation, or as the result of any probable malfunction in the charging system or battery installation, may accumulate in hazardous quantities within the airplane.

(4) No corrosive fluids or gases that may escape from the battery may damage surrounding airplane structures or adjacent essential equipment.

(5) Each nickel cadmium battery installation capable of being used to start an engine or auxiliary power unit must have provisions to prevent any hazardous effect on structure or essential systems that may be

caused by the maximum amount of heat the battery can generate during a short circuit of the battery or of its individual cells.

(6) Nickel cadmium battery installations capable of being used to start an engine or auxiliary power unit must have—

(i) A system to control the charging rate of the battery automatically so as to prevent battery overheating;

(ii) A battery temperature sensing and over-temperature warning system with a means for disconnecting the battery from its charging source in the event of an over-temperature condition; or

(iii) A battery failure sensing and warning system with a means for disconnecting the battery from its charging source in the event of battery failure.

§ 25.1355 Distribution system.

(a) The distribution system includes the distribution busses, their associated feeders, and each control and protective device.

(b) [Revoked.]

(c) If two independent sources of electrical power for particular equipment or systems are required by this chapter, in the event of the failure of one power source for such equipment or system, another power source (including its separate feeder) must be automatically provided or be manually selectable to maintain equipment or system operation.

§ 25.1357 Circuit protective devices.

(a) Automatic protective devices must be used to minimize distress to the electrical sys-

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tem and hazard to the airplane in the event of wiring faults or serious malfunction of the system or connected equipment.

(b) The protective and control devices in the generating system must be designed to de-energize and disconnect faulty power sources and power transmission equipment from their associated busses with sufficient rapidity to provide protection from hazardous over-voltage and other malfunctioning.

(c) Each resettable circuit protective device must be designed so that, when an overload or circuit fault exists, it will open the circuit irrespective of the position of the operating control.

(d) If the ability to reset a circuit breaker or replace a fuse is essential to safety in flight, that circuit breaker or fuse must be located and identified so that it can be readily reset or replaced in flight.

(e) Each circuit for essential loads must have individual circuit protection. However, individual protection for each circuit in an essential load system (such as each position light circuit in a system) is not required.

(f) If fuses are used, there must be spare fuses for use in flight equal to at least 50 percent of the number of fuses of each rating required for complete circuit protection.

(g) Automatic reset circuit breakers may be used as integral protectors for electrical equipment (such as thermal cut-outs) if there is circuit protection to protect the cable to the equipment.

§ 25.1359 Electrical system fire and smoke protection.

(a) Components of the electrical system must meet the applicable fire and smoke protection requirements of §§ 25.831(c), 25.863, and [25.867.]

(b) Electrical cables, terminals, and equipment in designated fire zones, that are used during emergency procedures, must be at least fire resistant.

(c) Main power cables (including generator cables) in the fuselage must be designed to allow a reasonable degree of deformation and stretching without failure and must—

(1) Be isolated from flammable fluid lines; or

(2) Be shrouded by means of electrically insulated flexible conduit, or equivalent, which is in addition to the normal cable insulation.

(d) Insulation on electrical wire and electrical cable installed in any area of the fuselage must be self-extinguishing when tested at an agle of 60° in accordance with the applicable portions of Appendix F of this Part, or other approved equivalent methods. The average burn length may not exceed 3 inches and the average flame time after removal of the flame source may not exceed 30 seconds. Drippings from the test specimen may not continue to flame for more than an average of 3 seconds after falling.

§ 25.1363 Electrical system tests.

(a) When laboratory tests of the electrical system are conducted—

(1) The tests must be performed on a mockup using the same generating equipment used in the airplane;

(2) The equipment must simulate the electrical characteristics of the distribution wiring and connected loads to the extent necessary for valid test results; and

(3) Laboratory generator drives must simulate the actual prime movers on the airplane with respect to their reaction to generator loading, including loading due to faults.

(b) For each flight condition that cannot be simulated adequately in the laboratory or by ground tests on the airplane, flight tests must be made.

§ 25.1369 [Revoked.]

LIGHTS

§ 25.1381 Instrument lights.

(a) The instrument lights must—

(1) Make each instrument, switch, and other device for which they are provided easily readable; and

(2) Be installed so that—

(i) Their direct rays are shielded from the pilot's eyes; and

(ii) No objectionable reflections are visible to the pilot.

(b) Unless undimmed instrument lights are satisfactory under each expected flight condition, there must be a means to control the intensity of illumination.

§ 25.1383 Landing lights.

(a) Each landing light must be approved, and must be installed so that—

(1) No objectionable glare is visible to the pilot;

(2) The pilot is not adversely affected by halation; and

(3) It provides enough light for night landing.

(b) Except when one switch is used for the lights of a multiple light installation at one location, there must be a separate switch for each light.

(c) There must be a means to indicate to the pilots when the landing lights are extended.

§ 25.1385 Position light system installation.

(a) *General.* Each part of each position light system must meet the applicable requirements of this section and each system as a whole must meet the requirements of §§ 25.1387 through 25.1397.

(b) *Forward position lights.* Forward position lights must consist of a red and a green light spaced laterally as far apart as practicable and installed forward on the airplane so that, with the airplane in the normal flying position, the red light is on the left side, and the green light is on the right side. Each light must be approved.

(c) *Rear position light.* The rear position light must be a white light mounted as far aft as practicable on the tail or on each wing tip, and must be approved.

(d) *Light covers and color filters.* Each light cover or color filter must be at least flame resistant and may not change color or shape or lose any appreciable light transmission during normal use.

(e) [Deleted]

§ 25.1387 Position light system dihedral angles.

(a) Except as provided in paragraph (e) of this section, each forward and rear position light must, as installed, show unbroken light within the dihedral angles described in this section.

(b) Dihedral angle *L* (left) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110° to the left of the first, as viewed when looking forward along the longitudinal axis.

(c) Dihedral angle *R* (right) is formed by two intersecting vertical planes, the first parallel to the longitudinal axis of the airplane, and the other at 110° to the right of the first, as viewed when looking forward along the longitudinal axis.

(d) Dihedral angle *A* (aft) is formed by two intersecting vertical planes making angles of 70° to the right and to the left, respectively, to a vertical plane passing through the longitudinal axis, as viewed when looking aft along the longitudinal axis.

(e) If the rear position light, when mounted as far aft as practicable in accordance with § 25.1385(c), cannot show unbroken light within dihedral angle A (as defined in paragraph (d) of this section), a solid angle or angles of obstructed visibility totaling not more than 0.04 steradians is allowable within that dihedral angle, if such solid angle is within a cone whose apex is at the rear position light and whose elements make an angle of 30° with a vertical line passing through the rear position light.

§ 25.1389 Position light distribution and intensities.

(a) *General.* The intensities prescribed in this section must be provided by new equipment with light covers and color filters in place. Intensities must be determined with the light source operating at a steady value equal to the average luminous output of the source at the normal operating voltage of the airplane. The light distribution and intensity of each position light must meet the requirements of paragraph (b) of this section.

(b) *Forward and rear position lights.* The light distribution and intensities of forward and rear position lights must be expressed in terms of minimum intensities in the horizontal plane, minimum intensities in any vertical plane, and maximum intensities in overlapping beams, within dihedral angles *L*, *R*, and *A*, and must meet the following requirements:

(1) *Intensities in the horizontal plane.* Each intensity in the horizontal plane (the plane containing the longitudinal axis of the airplane and perpendicular to the plane of symmetry of the airplane) must equal or exceed the values in § 25.1391.

(2) *Intensities in any vertical plane.* Each intensity in any vertical plane (the plane perpendicular to the horizontal plane) must equal or exceed the appropriate value in § 25.1393, where *I* is the minimum intensity prescribed in § 25.1391 for the corresponding angles in the horizontal plane.

(3) *Intensities in overlaps between adjacent signals.* No intensity in any overlap between adjacent signals may exceed the values given in § 25.1395, except that higher intensities in overlaps may be used with main beam intensities substantially greater than the minima specified in §§ 25.1391 and 25.1393 if the overlap intensities in relation to the main beam intensities do not adversely affect signal clarity. When the peak intensity of the forward position lights is more than 100 candles, the maximum overlap intensities between them may exceed the values given in § 25.1395 if the overlap intensity in Area A is not more than 10 percent of peak position light intensity and the overlap intensity in Area B is not greater than 2.5 percent of peak position light intensity.

§ 25.1391 Minimum intensities in the horizontal plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table:

Dihedral angle (light included)	Angle from right or left of longitudinal axis, measured from dead ahead	Intensity (candles)
L and *R* (forward red and green).	0° to 10°	40
	10° to 20°	30
	20° to 110°	5
A (rear white)	110° to 180°	20

§ 25.1393 Minimum intensities in any vertical plane of forward and rear position lights.

Each position light intensity must equal or exceed the applicable values in the following table:

Angle above or below the horizontal plane:	*Intensity*
0°	1.00 *I*.
0° to 5°	0.90 *I*.
5° to 10°	0.80 *I*.
10° to 15°	0.70 *I*.
15° to 20°	0.50 *I*.
20° to 30°	0.30 *I*.
30° to 40°	0.10 *I*.
40° to 90°	0.05 *I*.

§ 25.1395 Maximum intensities in overlapping beams of forward and rear position lights.

No position light intensity may exceed the applicable values in the following table, except as provided in § 25.1389(b)(3).

Overlaps	Maximum intensity	
	Area A (candles)	Area B (candles)
Green in dihedral angle *L*	10	1
Red in dihedral angle *R*	10	1
Green in dihedral angle *A*	5	1
Red in dihedral angle A	5	1
Rear white in dihedral angle *L*	5	1
Rear white in dihedral angle *R*	5	1

Where—

(a) Area A includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 10° but less than 20°; and

(b) Area B includes all directions in the adjacent dihedral angle that pass through the light source and intersect the common boundary plane at more than 20°.

§ 25.1397 Color specifications.

Each position light color must have the applicable International Commission on Illumination chromaticity coordinates as follows:

(a) *Aviation red*—

"y" is not greater than 0.335; and
"z" is not greater than 0.002.

(b) *Aviation green*—

"x" is not greater than $0.440-0.320y$;
"x" is not greater than $y-0.170$; and
"y" is not less than $0.390-0.170x$.

(c) *Aviation white*—

"x" is not less than 0.300 and not greater than 0.540;

"y" is not less than "x"-0.040" or "$y_o-0.010$", whichever is the smaller; and

"y" is not greater than "$x+0.020$" nor "$0.636-0.400x$";

Where "y_o" is the "y" coordinate of the Planckian radiator for the value of "x" considered.

§ 25.1399 Riding light.

(a) Each riding (anchor) light required for a seaplane or amphibian must be installed so that it can—

(1) Show a white light for at least two nautical miles at night under clear atmospheric conditions; and

(2) Show the maximum unbroken light practicable when the airplane is moored or drifting on the water.

(b) Externally hung lights may be used.

§ 25.1401 Anticollision light system.

(a) *General.* The airplane must have an anticollision light system that—

(1) Consists of one or more approved anticollision lights located so that their light will not impair the crew's vision or detract from the conspicuity of the position lights; and

(2) Meets the requirements of paragraphs (b) through (f) of this section.

(b) *Field of coverage.* The system must consist of enough lights to illuminate the vital areas around the airplane considering the physical configuration and flight characteristics of the airplane. The field of coverage must extend in each direction within at least [75°] above and [75°] below the horizontal plane of the airplane, except that a solid angle or angles of obstructed visibility totaling not more than 0.03 steradians is allowable within a solid angle equal to 0.15 steradians centered about the longitudinal axis in the rearward direction.

(c) *Flashing characteristics.* The arrangement of the system, that is, the number of light sources, beam width, speed of rotation, and other characteristics, must give an effective flash frequency of not less than 40, nor more than 100, cycles per minute. The effective flash frequency is the frequency at which the airplane's complete anticollision light system is observed from a distance, and applies to each sector of light including any overlaps that exist when the system consists of more than one light source. In overlaps, flash frequencies may exceed 100, but not 180, cycles per minute.

(d) *Color.* Each anticollision light must be either aviation red or aviation white and must meet the applicable requirements of § 25.1397.

(e) *Light intensity.* The minimum light intensities in all vertical planes, measured with the red filter (if used) and expressed in terms of "effective" intensities, must meet the requirements of paragraph (f) of this section. The following relation must be assumed:

$$I_e = \frac{\int_{t_1}^{t_2} I(t)\,dt}{0.2+(t_2-t_1)} \;;$$

where:

I_e=effective intensity (candles).
$I(t)$=instantaneous intensity as a function of time.
t_2-t_1=flash time interval (seconds).

Normally, the maximum value of effective intensity is obtained when t_2 and t_1 are chosen so that the effective intensity is equal to the instantaneous intensity at t_2 and t_1.

(f) *Minimum effective intensities for anticollision lights.* Each anticollision light effective intensity must equal or exceed the applicable values in the following table.

Angle above or below the horizontal plane:	*Effective intensity (candles)*
0° to 5°	400
5° to 10°	240
10° to 20°	80
20° to 30°	40
30° to 75°	20

§ 25.1403 Wing icing detection lights.

Unless operations at night in know or forecast icing conditions are prohibited by an operating limitation, a means must be provided for illuminating or otherwise determining the formation of ice on the parts of the wings that are critical from the standpoint of ice accumulation. Any illumination that is used must be of a type that will not cause glare or reflection that would handicap crewmembers in the performance of their duties.

SAFETY EQUIPMENT

§ 25.1411 General.

(a) *Accessibility.* (1) Required safety equipment to be used by the crew in an emergency must be readily accessible.

[(2) At least one public address system microphone intended for flight attendant use must be positioned adjacent to a flight attendant seat that is located near each required floor level emergency exit in the passenger compartment and be readily accessible to the seated flight attendant.]

(b) *Stowage provisions.* Stowage provisions for required emergency equipment must be furnished and must—

(1) Be arranged so that the equipment is directly accessible and its location is obvious; and

(2) Protect the safety equipment from inadvertent damage.

(c) *Emergency exit descent device.* The stowage provisions for the emergency exit descent device required by § 25.809(f) must be at the exits for which they are intended.

(d) *Liferafts.* (1) The stowage provisions for the liferafts described in § 25.1415 must accommodate enough rafts for the maximum number of occupants for which certification for ditching is requested.

(2) Liferafts must be stowed near exits through which the rafts can be launched during an unplanned ditching.

(3) Rafts automatically or remotely released outside the airplane must be attached to the airplane by means of the static line prescribed in § 25.1415.

(4) The stowage provisions for each portable liferaft must allow rapid detachment and removal of the raft for use at other than the intended exits.

(e) *Long-range signaling device.* The stowage provisions for the long-range signaling device required by § 25.1415 must be near an exit available during an unplanned ditching.

(f) *Life preserver stowage provisions.* The stowage provisions for life preservers described in § 25.1415 must accommodate one life preserver for each occupant for which certification for ditching is requested. Each life preserver must be within easy reach of each seated occupant.

(g) *Life line stowage provisions.* If certification for ditching under § 25.801 is requested, there must be provisions to store life lines. These provisions must—

(1) Allow one life line to be attached to each side of the fuselage; and

(2) Be arranged to allow the life lines to be used to enable the occupants to stay on the wing after ditching.

§ 25.1413 Safety belts.

(a) If there are means to indicate to the passengers when safety belts should be fastened, they must be installed to be operated from either pilot seat.

(b) The rated strength of safety belts may not be less than that required to withstand the ultimate load factors specified in § 25.561, considering the dimensional characteristics of the belt installation for the specific seat or berth arrangement.

(c) Each belt and shoulder harness must be attached so that no part of the anchorage can fail at a load lower than that which would result from the application of ultimate load factors equal to those specified in § 25.561, multiplied by a factor of 1.33. This factor must be used instead of the fitting factor prescribed in § 25.625. The forward load factor need not be applied to safety belts for berths.

(d) Each safety belt must be equipped with a metal to metal latching device.

§ 25.1415 Ditching equipment.

(a) Ditching equipment used in airplanes to be certificated for ditching under § 25.801, and operated under the operating rules of this chapter, must meet the requirements of this section.

(b) Each liferaft and each life preserver must be approved. In addition—

(1) Unless excess rafts of enough capacity are provided, the buoyancy and seating capacity beyond the rated capacity of the rafts must accommodate all occupants of the airplane in the event of a loss of one raft of the largest rated capacity; and

(2) Each raft must have a trailing line, and must have a static line designed to hold the raft near the airplane but to release it if the airplane becomes totally submerged.

(c) Approved survival equipment must be attached to each liferaft.

(d) There must be a survival type emergency locator transmitter that meets the applicable requirements of [TSO-C91] for use in one life raft.

(e) For airplanes not certificated for ditching under § 25.801 and not having approved life preservers, there must be an approved flotation means for each occupant. This means must be within easy reach of each seated occupant and must be readily removable from the airplane.

§ 25.1416 Pneumatic de-icer boot system.

If certification with ice protection provisions is desired and a pneumatic de-icer boot system is installed—

(a) The system must meet the requirements specified in § 25.1419.

(b) The system and its components must be designed to perform their intended function under any normal system operating temperature or pressure, and

(c) Means to indicate to the flight crew that the pneumatic de-icer boot system is receiving adequate pressure and is functioning normally must be provided.

§ 25.1419 Ice protection.

(a) If certification with ice protection provisions is desired, compliance with this section must be shown.

(b) The airplane must be able to safely operate in the continuous maximum and intermittent maximum icing conditions determined under Appendix C. An analysis must be performed to establish, on the basis of the airplane's operational needs, the adequacy of the ice protection system for the various components of the airplane.

(c) In addition to the analysis and physical evaluation prescribed in paragraph (b) of this section, the effectiveness of the ice protection system and its components must be shown by flight tests of the airplane or its components in measured natural atmospheric icing conditions and by one or more of the following tests as found necessary to determine the adequacy of the ice protection system:

(1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.

(2) Flight dry air tests of the ice protection system as a whole, or of its individual components.

(3) Flight tests of the airplane or its components in measured simulated icing conditions.

(d) For turbine engine powered airplanes, the ice protection provisions of this section are considered to be applicable primarily to the airframe. For the powerplant installation, certain additional provisions of Subpart E of this Part may be found applicable.

§ 25.1421 Megaphones.

If a megaphone is installed, a restraining means must be provided that is capable of restraining the megaphone when it is subjected to the ultimate inertia forces specified in § 25.561(b)(3).

MISCELLANEOUS EQUIPMENT

§ 25.1431 Electronic equipment.

(a) In showing compliance with § 25.1309 (a) and (b) with respect to radio and electronic equipment and their installations, critical environmental conditions must be considered.

(b) Radio and electronic equipment must be supplied with power under the requirements of § 25.1355(c).

(c) Radio and electronic equipment, controls, and wiring must be installed so that op-

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eration of any one unit or system of units will not adversely affect the simultaneous operation of any other radio or electronic unit, or system of units, required by this chapter.

§ 25.1433 Vacuum systems.

(a) There must be means, in addition to the normal pressure relief, to automatically relieve the pressure in the discharge lines from the vacuum air pump when the delivery temperature of the air becomes unsafe.

(b) Each vacuum air system line and fitting on the discharge side of the pump that might contain flammable vapors or fluids must meet the requirements of § 25.1183 if they are in a designated fire zone.

(c) Other vacuum air system components in designated fire zones must be at least fire resistant.

§ 25.1435 Hydraulic systems.

(a) *Design.* Each hydraulic system must be designed as follows:

(1) Each element of the hydraulic system must be designed to withstand the design operating pressure loads in combination with limit structural loads which may be imposed without deformation that would prevent it from performing its intended function, and to withstand, without rupture, the design operating pressure loads multiplied by a factor of 1.5 in combination with ultimate structural loads that can reasonably occur simultaneously. Design operating pressure is maximum normal operating pressure, excluding transient pressure.

[(2) A means to indicate system pressure and a means to indicate fluid quantity, both located at a flight crewmember station, must be provided for each hydraulic system that—

[(i) Performs a function that is essential for continued safe flight and landing; or

[(ii) In the event of hydraulic system malfunction, requires corrective action by the crew to ensure continued safe flight and landing.

[(3) [Reserved]]

(4) There must be means to ensure that system pressures, including transient pressures and pressures from fluid volumetric changes in components which are likely to remain closed long enough for such changes to occur—

(i) Will be within 90 to 110 percent of pump average discharge pressure at each pump outlet or at the outlet of the pump transient pressure dampening device, if provided; and

[(ii) Except as provided in paragraph (a)(7) of this section, will not exceed 125 percent of the design operating pressure, excluding pressure at the outlets specified in paragraph (a)(4)(i) of this section. Design operating pressure is the maximum steady operating pressure.]

(5) Each hydraulic element must be installed and supported to prevent excessive vibration, abrasion, corrosion, and mechanical damage, and to withstand inertia loads. If a hydraulic fluid which could be harmful to occupants when liberated in any form is used, there must be a means to prevent harmful or hazardous concentration of the fluid or vapors in the crew or passenger compartments during flight.

(6) Means for providing flexibility must be used to connect points in a hydraulic fluid line between which relative motion or differential vibration exists.

[(7) Transient pressure in a part of the system may exceed the limit specified in paragraph (a)(4)(ii) of this section if—

[(i) A survey of those transient pressures is conducted to determine their magnitude and frequency; and

[(ii) Based on the survey, the fatigue strength of that part of the system is substantiated by analysis or tests, or both.

[(8) Each hydraulic pump must be designed and installed so that loss of hydraulic fluid to the pump cannot create a hazard that might prevent continued safe flight and landing.]

(b) *Tests.* (1) A complete hydraulic system must be static tested to show that it can withstand a pressure of 1.5 times the design operating pressure without a deformation of any part of the system that would prevent it from performing its intended function. Clearance between structural members and hydraulic system elements must be adequate and there must be no permanent detrimental deformation. For the purpose of this test, the pressure relief valve may be made inoperable to permit application of the required pressure.

(2) Compliance with § 25.1309 for hydraulic systems must be shown by functional tests, endurance tests, and analyses. The entire system or appropriate subsystems must be tested in an airplane or in a mockup installation to determine proper performance and proper relation to other aircraft systems. The functional tests must include simulation of hydraulic system failure conditions. The tests must account for flight loads, ground loads, and hydraulic system design operating and transient pressures expected during normal operation, but need not account for vibration loads or for loads due to temperature effects. Endurance tests must simulate the repeated complete flights that could be expected to occur in service. Elements which fail during the tests must be modified in order to have the design deficiency corrected and, where necessary, must be sufficiently retested. Simulation of operating and environmental conditions must be completed on elements and appropriate portions of the hydraulic system to the extent necessary to evaluate the environmental effects.

(c) *Fire protection.* Each hydraulic system using flammable hydraulic fluid must meet the applicable requirements of §§ 25.863, 25.1183, 25.1185, and 25.1189.

[§ 25.1438 Pressurization and pneumatic systems.

[(a) Pressurization system elements must be burst pressure tested to 2.0 times, and proof pressure tested to 1.5 times, the maximum normal operating pressure.

[(b) Pneumatic system elements must be burst pressure tested to 3.0 times, and proof pressure tested to 1.5 times, the maximum normal operating pressure.

[(c) An analysis, or a combination of analysis and test, may be substituted for any test required by paragraph (a) or (b) of this section if the Administrator finds it equivalent to the required test.]

§ 25.1439 Protective breathing equipment.

(a) If there is a class A, B, or E cargo compartment, protective breathing equipment must be installed for the use of appropriate crewmembers. In addition, protective breathing equipment must be installed in each isolated separate compartment in the airplane, including upper and lower lobe galleys, in which crewmember occupancy is permitted during flight for the maximum number of crewmembers expected to be in the area during any operation.

(b) For protective breathing equipment required by paragraph (a) of this section or by any operating rule of this chapter, the following apply:

(1) The equipment must be designed to protect the flight crew from smoke, carbon dioxide, and other harmful gases while on flight deck duty and while combating fires in cargo compartments.

(2) The equipment must include--

(i) Masks covering the eyes, nose, and mouth; or

(ii) Masks covering the nose and mouth, plus accessory equipment to cover the eyes.

(3) The equipment, while in use, must allow the flight crew to use the radio equipment and to communicate with each other, while at their assigned duty stations.

(4) The part of the equipment protecting the eyes may not cause any appreciable adverse effect on vision and must allow corrective glasses to be worn.

(5) The equipment must supply protective oxygen of 15 minutes duration per crewmember at a pressure altitude of 8,000 feet with a respiratory minute volume of 30 liters per minute BTPD. If a demand oxygen system is used, a supply of 300 liters of free

oxygen at 70° F. and 760 mm. Hg pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. If a continuous flow protective breathing system is used (including a mask with a standard rebreather bag) a flow rate of 60 liters per minute at 8,000 feet (45 liters per minute at sea level) and a supply of 600 liters of free oxygen at 70° F. and 760 mm. Hg pressure is considered to be of 15-minute duration at the prescribed altitude and minute volume. BTPD refers to body temperature conditions (that is, 37° C., at ambient pressure, dry).

(6) The equipment must meet the requirements of paragraphs (b) and (c) of § 25.1441.

§ 25.1441 Oxygen equipment and supply.

(a) If certification with supplemental oxygen equipment is requested, the equipment must meet the requirements of this section and §§ 25.1443 through 25.1453.

(b) The oxygen system must be free from hazards in itself, in its method of operation, and in its effect upon other components.

(c) There must be a means to allow the crew to readily determine, during flight, the quantity of oxygen available in each source of supply.

(d) The oxygen flow rate and the oxygen equipment for airplanes for which certification for operation above 40,000 feet is requested must be approved.

§ 25.1443 Minimum mass flow of supplemental oxygen.

(a) If continuous flow equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each crewmember may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 149 mm. Hg when breathing 15 liters per minute, BTPS, and with a maximum tidal volume of 700 cc. with a constant time interval between respirations.

(b) If demand equipment is installed for use by flight crewmembers, the minimum mass flow of supplemental oxygen required for each crewmember may not be less than the flow required to maintain, during inspiration, a mean tracheal oxygen partial pressure of 122 mm. Hg, up to and including a cabin pressure altitude of 35,000 feet, and 95 percent oxygen between cabin pressure altitudes of 35,000 and 40,000 feet, when breathing 20 liters per minute BTPS. In addition, there must be means to allow the crew to use undiluted oxygen at their discretion.

(c) For passengers and cabin attendants, the minimum mass flow of supplemental oxygen required for each person at various cabin pressure altitudes may not be less than the flow required to maintain, during inspiration and while using the oxygen equipment (including masks) provided, the following mean tracheal oxygen partial pressures:

(1) At cabin pressure altitudes above 10,000 feet up to and including 18,500 feet, a mean tracheal oxygen partial pressure of 100 mm. Hg when breathing 15 liters per minute, BTPS, and with a tidal volume of 700 cc. with a constant time interval between respirations.

(2) At cabin pressure altitudes above 18,500 feet up to and including 40,000 feet, a mean tracheal oxygen partial pressure of 83.8 mm. Hg when breathing 30 liters per minute, BTPS, and with a tidal volume of 1,100 cc. with a constant time interval between respirations.

(d) If first-aid oxygen equipment is installed, the minimum mass flow of oxygen to each user may not be less than four liters per minute, STPD. However, there may be a means to decrease this flow to not less than two liters per minute, STPD, at any cabin altitude. The quantity of oxygen required is based upon an average flow rate of 3 liters per minute per person for whom first-aid oxygen is required.

(e) If portable oxygen equipment is installed for use by crewmembers, the minimum mass flow of supplemental oxygen is the same as specified in paragraph (a) or (b) of this section, whichever is applicable.

§ 25.1445 Equipment standards for the oxygen distributing system.

(a) When oxygen is supplied to both crew and passengers, the distribution system must be designed for either—

(1) A source of supply for the flight crew on duty and a separate source for the passengers and other crewmembers; or

(2) A common source of supply with means to separately reserve the minimum supply required by the flight crew on duty.

(b) Portable walk-around oxygen units of the continuous flow, diluter-demand, and straight demand kinds may be used to meet the crew or passenger breathing requirements.

§ 25.1447 Equipment standards for oxygen dispensing units.

If oxygen dispensing units are installed, the following apply:

(a) There must be an individual dispensing unit for each occupant for whom supplemental oxygen is to be supplied. Units must be designed to cover the nose and mouth and must be equipped with a suitable means to retain the unit in position on the face. Flight crew masks for supplemental oxygen must have provisions for the use of communication equipment.

(b) If certification for operation up to and including 25,000 feet is requested, an oxygen supply terminal and unit of oxygen dispensing equipment for the immediate use of oxygen by each crewmember must be within easy reach of that crewmember. For any other occupants, the supply terminals and dispensing equipment must be located to allow the use of oxygen as required by the operating rules in this chapter.

(c) If certification for operation above 25,000 feet is requested, there must be oxygen dispensing equipment meeting the follouing requirements:

[(1) There must be an oxygen dispensing unit connected to oxygen supply terminals immediately available to each occupant, wherever seated. If certification for operation above 30,000 feet is requested, the dispensing units providing the required oxygen flow must be automatically presented to the occupants before the cabin pressure altitude exceeds 15,000 feet and the crew must be provided with a manual means to make the dispensing units immediately available in the event of failure of the automatic system. The total number of dispensing units and outlets must exceed the number of seats by at least 10 percent. The extra units must be as uniformly distributed throughout the cabin as practicable.

[(2) Each flight crewmember on flight deck duty must be provided with demand equipment. In addition, each flight crewmember must be provided with a quick-donning type of oxygen dispensing unit, connected to an oxygen supply terminal, that is immediately available to him when seated at his station, and that is designed and installed so that it—

[(i) Can be placed on the face from its ready position, properly secured, sealed, and supplying oxygen upon demand, with one hand within five seconds and without disturbing eyeglasses or causing delay in proceeding with emergency duties; and

[(ii) Allows, while in place, the performance of normal communication functions.]

(3) There must be at least two outlets and units of dispensing equipment of a type similar to that required by subparagraph (1) of this paragraph in—

(i) Each washroom; and

(ii) Each lavatory, if separate from the washroom.

(4) Portable oxygen equipment must be immediately available for each cabin attendant.

§ 25.1449 Means for determining use of oxygen.

There must be a means to allow the crew to determine whether oxygen is being delivered to the dispensing equipment.

[§ 25.1450 Chemical oxygen generators.

[(a) For the purpose of this section, a chemical oxygen generator is defined as a device which produces oxygen by chemical reaction.

[(b) Each chemical oxygen generator must be designed and installed in accordance with the following requirements:

[(1) Surface temperature developed by the generator during operation may not create a hazard to the airplane or to its occupants.

[(2) Means must be provided to relieve any internal pressure that may be hazardous.

[(c) In addition to meeting the requirements in paragraph (b) of this section, each portable chemical oxygen generator that is capable of sustained operation by successive replacement of a generator element must be placarded to show—

[(1) The rate of oxygen flow, in liters per minute;

[(2) The duration of oxygen flow, in minutes, for the replaceable generator element; and

[(3) A warning that the replaceable generator element may be hot, unless the element construction is such that the surface temperature cannot exceed 100 degrees F.]

§ 25.1451 Fire protection for oxygen equipment.

(1) Oxygen equipment and lines may not be in any designated fire zone.

(b) Oxygen equipment and lines must be protected from heat that may be generated in, or escape from, any designated fire zone.

(c) Oxygen equipment and lines must be installed so that escaping oxygen cannot cause ignition of grease, fluid, or vapor accumulations that are present in normal operation or as a result of failure or malfunction of any system.

§ 25.1453 Protection of oxygen equipment from rupture.

Oxygen pressure tanks, and lines between tanks and the shutoff means, must be—

(a) Protected from unsafe temperatures; and

(b) Located where the probability and hazards of rupture in a crash landing are minimized.

§ 25.1455 Draining of fluids subject to freezing.

If fluids subject to freezing may be drained overboard in flight or during ground operation, the drains must be designed and located to prevent the formation of hazardous quantities of ice on the airplane as a result of the drainage.

§ 25.1457 Cockpit voice recorders.

(a) Each cockpit voice recorder required by the operating rules of this chapter must be approved and must be installed so that it will record the folowing:

(1) Voice communications transmitted from or received in the airplane by radio.

(2) Voice communications of flight crewmembers on the flight deck.

(3) Voice communications of flight crewmembers on the flight deck, using the airplane's interphone system.

(4) Voice or audio signals identifying navigation or approach aids introduced into a headset or speaker.

(5) Voice communications of flight crewmembers using the passenger loudspeaker system, if there is such a system and if the fourth channel is available in accordance with the requirements of paragraph (c)(4)(ii) of this section.

(b) The recording requirements of paragraph (a)(2) of this section must be met by installing a cockpit-mounted area microphone, located in the best position for recording voice communications originating at the first and second pilot stations and voice communications of other crewmembers on the flight deck when directed to those stations. The microphone must be so located and, if necessary, the preamplifiers and filters of the recorder must be so adjusted or supplemented, that the intelligibility of the recorded communications is as high as practicable when recorded under flight cockpit noise conditions and played back. Repeated aural or visual playback of the record may be used in evaluating intelligibility.

(c) Each cockpit voice recorder must be installed so that the part of the communication or audio signals specified in paragraph (a) of this section obtained from each of the following sources is recorded on a separate channel:

(1) [For the first channel, from each boom, mask, or hand-held microphone, headset, or speaker used at the first pilot station.

(2) [For the second channel, from each boom, mask, or hand-held microphone, headset, or speaker used at the second pilot station.

(3) [For the third channel—from the cockpit-mounted area microphone.

(4) [For the fourth channel, from—

(i) [Each boom, mask, or hand-held microphone, headset, or speaker used at the stations for the third and fourth crewmembers; or]

(ii) If the stations specified in subdivision (i) of this subparagraph are not required or if the signal at such a station is picked up by another channel, each microphone on the flight deck that is used with the passenger loudspeaker system, if its signals are not picked up by another channel.

[(5)] As far as is practicable all sounds received by the microphone listed in paragraphs (c)(1), (2), and (4) of this section must be recorded without interruption irrespective of the position of the interphone-transmitter key switch. The design shall ensure that sidetone for the flight crew is produced only when the interphone, public address system, or radio transmitters are in use.]

(d) Each cockpit voice recorder must be installed so that—

(1) It receives its electric power from the bus that provides the maximum reliability for operation of the cockpit voice recorder without jeopardizing service to essential or emergency loads;

(2) There is an automatic means to simultaneously stop the recorder and prevent each erasure feature from functioning, within 10 minutes after crash impact; and

(3) There is an aural or visual means for preflight checking of the recorder for proper operation.

(e) The record container must be located and mounted to minimize the probability of rupture of the container as a result of crash impact and consequent heat damage to the record from fire. In meeting this requirement, the record container must be as far aft as practicable, but may not be where aft mounted engines may crush the container during impact. However, it need not be outside of the pressurized compartment.

(f) If the cockpit voice recorder has a bulk erasure device, the installation must be designed to minimize the probability of inadvertent operation and actuation of the device during crash impact.

(g) Each recorder container must—

(1) Be either bright orange or bright yellow;

(2) Have reflective tape affixed to its external surface to facilitate its location under water; and

(3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such manner that they are not likely to be separated during crash impact.

§ 25.1459 Flight recorders.

(a) Each flight recorder required by the operating rules of this chapter must be installed so that—

(1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of §§ 25.1323, 25.1325, and 25.1327, as appropriate;

(2) The vertical acceleration sensor is rigidly attached, and located longitudinally either within the approved center of gravity limits of the airplane, or at a distance forward or aft of these limits that does not exceed 25 percent of the airplane's mean aerodynamic chord;

(3) It receives its electrical power from the bus that provides the maximum reliability for operation of the flight recorder without jeopardizing service to essential or emergency loads;

(4) [There is an aural or visual means for preflight checking of the recorder for proper recording of data in the storage medium.]

(5) Except for recorders powered solely by the engine-driven electrical generator system, there is an automatic means to simultaneously stop a recorder that has a data erasure feature and prevent each erasure

feature from functioning, within 10 minutes after crash impact; and

(6) There is a means to record data from which the time of each radio transmission either to or from ATC can be determined.

(7) [Deleted]

(b) Each nonejectable record container must be located and mounted so as to minimize the probability of container rupture resulting from crash impact and subsequent damage to the record from fire. In meeting this requirement the container must be located as far aft as practicable, but need not be aft of the pressurized compartment, and may not be where aft-mounted engines may crush the container upon impact.

(c) A correlation must be established between the flight recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. The correlation must cover the airspeed range over which the airplane is to be operated, the range of altitude to which the airplane is limited and 360 degrees of heading. Correlation may be established on the ground as appropriate.

(d) Each recorder container must—

(1) Be either bright orange or bright yellow;

(2) Have reflective tape affixed to its external surface to facilitate its location under water; and

(3) Have an underwater locating device, when required by the operating rules of this chapter, on or adjacent to the container which is secured in such a manner that they are not likely to be separated during crash impact.

[(e)**]** Any novel or unique design or operational characteristics of the aircraft shall be evaluated to determine if any dedicated parameters must be recorded on flight recorders in addition to or in place of existing requirements.**]**

§ 25.1461 Equipment containing high energy rotors.

(a) Equipment containing high energy rotors must meet paragraph (b), (c), or (d) of this section.

(b) High energy rotors contained in equipment must be able to withstand damage caused by malfunctions, vibration, abnormal speeds, and abnormal temperatures. In addition—

(1) Auxiliary rotor cases must be able to contain damage caused by the failure of high energy rotor blades; and

(2) Equipment control devices, systems, and instrumentation must reasonably ensure that no operating limitations affecting the integrity of high energy rotors will be exceeded in service.

(c) It must be shown by test that equipment containing high energy rotors can contain any failure of a high energy rotor that occurs at the highest speed obtainable with the normal speed control devices inoperative.

(d) Equipment containing high energy rotors must be located where rotor failure will neither endanger the occupants nor adversely affect continued safe flight.

Subpart G—Operating Limitations and Information

§ 25.1501 General.

(a) Each operating limitation specified in §§ 25.1503 through 25.1533 and other limitations and information necessary for safe operation must be established.

(b) The operating limitations and other information necessary for safe operation must be made available to the crewmembers as prescribed in §§ 25.1541 through 25.1587.

OPERATING LIMITATIONS

§ 25.1503 Airspeed limitations: general.

When airspeed limitations are a function of weight, weight distribution, altitude, or Mach number, limitations corresponding to each critical combination of these factors must be established.

§ 25.1505 Maximum operating limit speed.

The maximum operating limit speed (V_{MO}/M_{MO} airspeed or Mach number, whichever is critical at a particular altitude) is a speed that may not be deliberately exceeded in any regime of flight (climb, cruise, or descent), unless a higher speed is authorized for flight test or pilot training operations. V_{MO}/M_{MO}

must be established so that it is not greater than the design cruising speed V_C and so that it is sufficiently below V_D/M_D or V_{DF}/M_{DF}, to make it highly improbable that the latter speeds will be inadvertently exceeded in operations. The speed margin between V_{MO}/M_{MO} and V_D/M_D or V_{DF}/M_{DF} may not be less than that determined under § 25.335(b) or found necessary during the flight tests conducted under § 25.253.

§ 25.1507 Maneuvering speed.

The maneuvering speed must be established so that it does not exceed the design maneuvering speed V_A determined under § 25.335(c).

§ 25.1511 Flap extended speed.

The established flap extended speed V_{FE} must be established so that it does not exceed the design flap speed V_F chosen under §§ 25.335(e) and 25.345, for the corresponding flap positions and engine powers.

§ 25.1513 Minimum control speed.

The minimum control speed V_{MC} determined under § 25.149 must be established as an operating limitation.

§ 25.1515 Landing gear speeds.

(a) The established landing gear operating speed or speeds, V_{LO}, may not exceed the speed at which it is safe both to extend and to retract the landing gear, as determined under § 25.729 or by flight characteristics. If the extension speed is not the same as the retraction speed, the two speeds must be designated as $V_{LO(EXT)}$ and $V_{LO(RET)}$, respectively.

(b) The established landing gear extended speed V_{LE} may not exceed the speed at which it is safe to fly with the landing gear secured in the fully extended position, and that determined under § 25.729.

§ 25.1519 Weight, center of gravity, and weight distribution.

The airplane weight, center of gravity, and weight distribution limitations determined under §§ 25.23 through 25.27 must be established as operating limitation.

§ 25.1521 Powerplant limitations.

(a) *General.* The powerplant limitations prescribed in this section must be established so that they do not exceed the corresponding limits for which the engines or propellers are type certificated.

(b) *Takeoff operation.* The powerplant takeoff operation must be limited by—

(1) The maximum rotational speed (r.p.m.);

(2) The maximum allowable manifold pressure (for reciprocating engines);

(3) The maximum allowable gas temperature (for turbine engines);

(4) The time limit for the use of the power or thrust corresponding to the limitations established in [paragraphs (b)(1) through (3) of this section]; and

(5) If the time limit established in subparagraph (4) of this paragraph exceeds 2 minutes, or if the maximum cylinder head and oil temperatures differ from the maximum limits for continuous operation, the maximum allowable cylinder head (for reciprocating engines) and oil temperatures.

(c) *Continuous operation.* The continuous operation must be limited by—

(1) The maximum rotational speed;

(2) The maximum allowable manifold pressure (for reciprocating engines);

(3) The maximum allowable gas temperature (for turbine engines); and

(4) The maximum allowable cylinder head and oil temperatures.

(d) *Fuel grade or designation.* The minimum fuel grade (for reciprocating engines), or fuel designation (for turbine engines), must be established so that it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of this section.

(e) *Ambient temperature.* Ambient temperature limitation (including limitations for winterization installations if applicable) must be established as the maximum ambient atmospheric temperature at which compliance with the cooling provisions of §§ 25.1041 through 25.1045 is shown.

§ 25.1522 Auxiliary power unit limitations.

If an auxiliary power unit that meets the requirements of TSO-C77 (§ 37.183) is installed in the airplane, the limitations established for that auxiliary power unit under the TSO, including the categories of operation, must be specified as operating limitations for the airplane.

§ 25.1523 Minimum flight crew.

The minimum flight crew must be established so that it is sufficient for safe operation, considering—

(a) The workload on individual crewmembers;

(b) The assessibility and ease of operation of necessary controls by the appropriate crewmember; and

(c) The kind of operation authorized under § 25.1525.

The criteria used in making the determinations required by this section are set forth in Appendix D.

§ 25.1525 Kinds of operation.

The kinds of operation to which the airplane is limited are established by the category in which it is eligible for certification and by the installed equipment.

§ 25.1527 Maximum operating altitude.

The maximum altitude up to which operation is allowed, as limited by flight, structural, powerplant, functional, or equipment characteristics, must be established.

[§ 25.1529 Instructions for Continued Airworthiness.

[The applicant must prepare Instructions for Continued Airworthiness in accordance with Appendix H to this Part that are acceptable to the Administrator. The instructions may be incomplete at type certification if a program exists to ensure their completion prior to delivery of the first airplane or issuance of a standard certificate of airworthiness, whichever occurs later.]

§ 25.1531 Maneuvering flight load factors.

Load factor limitations, not exceeding the positive limit load factors determined from the maneuvering diagram in § 25.333(b), must be established.

§ 25.1533 Additional operating limitations.

(a) Additional operating limitations must be established as follows:

(1) The maximum takeoff weights must be estabished as the weights at which compliance is shown with the applicable provisions of this Part (including the takeoff climb provisions of § 25.12(a) through (c), for altitudes and ambient temperatures).

(2) The maximum landing weights must be established as the weights at which compliance is shown with the applicable provisions of this Part (including the landing and takeoff climb provisions of §§ 25.119 and 25.121 for altitudes and ambient temperatures).

(3) The minimum takeoff distances must be established as the distances at which compliance is shown with the applicable provisions of this Part (including the provisions

of §§ 25.109 and 25.113, for weights, altitudes, temperatures, wind components, and runway gradients).

(b) The extremes for variable factors (such as altitude, temperature, wind, and runway gradients) are those at which compliance with the applicable provisions of this Part is shown.

MARKINGS AND PLACARDS

§ 25.1541 General.

(a) The airplane must contain—

(1) The specified markings and placards; and

(2) Any additional information, instrument markings, and placards required for the safe operation if there are unusual design, operating, or handling characteristics.

(b) Each marking and placard prescribed in paragraph (a) of this section—

(1) Must be displayed in a conspicuous place; and

(2) May not be easily erased, disfigured, or obscured.

§ 25.1543 Instrument markings: general.

For each instrument—

(a) When markings are on the cover glass of the instrument, there must be means to maintain the correct alignment of the glass cover with the face of the dial; and

(b) Each arc and line must be wide enough, and located, to be clearly visible to the pilot.

§ 25.1545 Airspeed limitation information.

The airspeed limitations required by § 25.1583(a) must be easily read and understood by the flight crew.

§ 25.1547 Magnetic direction indicator.

(a) A placard meeting the requirements of this section must be installed on, or near, the magnetic direction indicator.

(b) The placard must show the calibration of the instrument in level flight with the engines operating.

(c) The placard must state whether the calibration was made with radio receivers on or off.

(d) Each calibration reading must be in terms of magnetic heading in not more than 45-degree increments.

§ 25.1549 Powerplant and auxiliary power unit instruments.

For each required powerplant and auxiliary power unit instrument, as appropriate to the type of instrument—

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red radial or a red line;

(b) Each normal operating range must be marked with a green arc or green line, not extending beyond the maximum and minimum safe limits;

(c) Each takeoff and precautionary range must be marked with a yellow arc or a yellow line; and

(d) Each engine, auxiliary power unit, or propeller speed range that is restricted because of excessive vibration stresses must be marked with red arcs or red lines.

§ 25.1551 Oil quantity indicator.

Each oil quantity indicator must be marked with enough increments to indicate readily and accurately the quantity of oil.

§ 25.1553 Fuel quantity indicator.

If the unusable fuel supply for any tank exceeds one gallon, or five percent of the tank capacity, whichever is greater, a red arc must be marked on its indicator extending from the calibrated zero reading to the lowest reading obtainable in level flight.

§ 25.1555 Control markings.

(a) Each cockpit control, other than primary flight controls and controls whose function is obvious, must be plainly marked as to its function and method of operation.

(b) Each aerodynamic control must be marked under the requirements of §§ 25.677 and 25.699.

(c) For powerplant fuel controls—

(1) Each fuel tank selector control must be marked to indicate the position corresponding to each tank and to each existing cross feed position;

(2) If safe operation requires the use of any tanks in a specific sequence, that sequence must be marked on, or adjacent to, the selector for those tanks; and

(3) Each valve control for each engine must be marked to indicate the position corresponding to each engine controlled.

(d) For accessory, auxiliary, and emergency controls—

(1) Each emergency control (including each fuel jettisoning and fluid shutoff control) must be colored red; and

(2) Each visual indicator required by § 25.729(e) must be marked so that the pilot can determine at any time when the wheels are locked in either extreme position, if retrackable landing gear is used.

§ 25.1557 Miscellaneous markings and placards.

(a) *Baggage and cargo compartments and ballast location.* Each baggage and cargo compartment, and each ballast location must have a placard stating any limitations on contents, including weight, that are necessary under the loading requirements. However, underseat compartments designed for the storage of carry-on articles weighing not more than 20 pounds need not have a loading limitation placard.

(b) *Fuel and oil filler openings.* The following apply:

(1) Fuel filler openings must be marked at or near the filler cover with—

(i) The word "fuel";

(ii) For reciprocating engine powered airplanes, the minimum fuel grade;

(iii) For turbine engine powered airplanes, the permissible fuel designations; and

(iv) For pressure fueling systems, the maximum permissible fueling supply pressure and the maximum permissible defueling pressure.

(2) Oil filler openings must be marked at or near the filler cover with the word "oil".

(c) *Emergency exit placards.* Each emergency exit placard must meet the requirements of § 25.811.

(d) *Doors.* Each door that must be used in order to reach any required emergency exit must have a suitable placard stating that the door is to be latched in the open position during takeoff and landing.

§ 25.1561 Safety equipment.

(a) Each safety equipment control to be operated by the crew in emergency, such as controls for automatic liferaft releases, must be plainly marked as to its method of operation.

(b) Each location, such as a locker or compartment, that carries any fire extinguishing, signaling, or other lifesaving equipment must be marked accordingly.

(c) Stowage provisions for required emergency equipment must be conspicuously marked to identify the contents and facilitate [the easy] removal of the equipment.

(d) Each liferaft must have obviously marked operating instructions.

(e) Approved survival equipment must be marked for identification and method of operation.

§ 25.1563 Airspeed placard.

A placard showing the maximum airspeeds for flap extension for the takeoff, approach, and landing positions must be installed in clear view of each pilot.

AIRPLANE FLIGHT MANUAL

§ 25.1581 General.

(a) *Furnishing information.* An Airplane Flight Manual must be furnished with each airplane, and it must contain the following:

(1) Information required by §§ 25.1583 through 25.1587.

(2) Other information that is necessary for safe operation because of design, operating, or handling characteristics.

(b) *Approved information.* Each part of the manual listed in §§ 25.1583 through 25.1587, that is appropriate to the airplane, must be furnished, verified, and approved, and must be segregated, identified, and clearly distinguished from each unapproved part of that manual.

(c) [Reserved]

(d) Each Airplane Flight Manual must include a table of contents if the complexity of the manual indicates a need for it.

§ 25.1583 Operating limitations.

(a) *Airspeed limitations.* The following airspeed limitations and any other airspeed limitations necessary for safe operation must be furnished:

(1) The maximum operating limit speed V_{MO}/M_{MO} and a statement that this speed limit may not be deliberately exceeded in any regime of flight (climb, cruise, or descent) unless a higher speed is authorized for flight test or pilot training.

(2) If an airspeed limitation is based upon compressibility effects, a statement to this effect and information as to any symptoms, the probable behavior of the airplane, and the recommended recovery procedures.

(3) The maneuvering speed V_A and a statement that full application of rudder and aileron controls, as well as maneuvers that involve angles of attack near the stall, should be confined to speeds below this value.

(4) The flap extended speed V_{FE} and the pertinent flap positions and engine powers.

(5) The landing gear operating speed or speeds, and a statement explaining the speeds as defined in § 25.1515(a).

(6) The landing gear extended speed V_{LE}, if greater than V_{LO}, and a statement that this is the maximum speed at which the airplane can be safely flown with the landing gear extended.

(b) *Powerplant limitations.* The following information must be furnished:

(1) Limitations required by § 25.1521.

(2) Explanation of the limitations, when appropriate.

(3) Information necessary for marking the instruments required by §§ 25.1549 through 25.1553.

(c) *Weight and loading distribution.* The weight and center of gravity limits required by §§ 25.25 and 25.27 must be furnished in the Airplane Flight Manual. All of the following information must be presented either in the Airplane Flight Manual or in a separate weight and balance control and loading document which is incorporated by reference in the Airplane Flight Manual:

(1) The condition of the airplane and the items included in the empty weight as defined in accordance with § 25.29.

(2) Loading instructions necessary to ensure loading of the airplane within the weight and center of gravity limits, and to maintain the loading within these limits in flight.

(3) If certification for more than one center of gravity range is requested, the appropriate limitations, with regard to weight and loading procedures, for each separate center of gravity range.

(d) *Fight crew.* The number and functions of the minimum flight crew determined under § 25.1523 must be furnished.

(e) *Kinds of operation.* The kinds of operation approved under § 25.1525 must be furnished

(f) *Altitudes.* The altitude established under § 25.1527 and an explanation of the limiting factors must be furnished.

[(g) [Reserved]**]**

(h) *Additional operating limitations.* The operating limitations established under § 25.1533 must be furnished.

(i) *Maneuvering flight load factors.* The positive maneuvering limit load factors for which the structure is proven, described in terms of accelerations, and a statement that these accelerations limit the angle of bank in turns and limit the severity of pull-up maneuvers, must be furnished.

§ 25.1585 Operating procedures.

(a) Information and instructions regarding the peculiarities of normal operations (including starting and warming the engines, taxiing, operation of wing flaps, landing gear, and the automatic pilot) must be furnished, together with recommended procedures for—

(1) Engine failure (including minimum speeds, trim, operation of the remaining engines, and operation of flaps);

(2) Stopping the rotation of propellers in flight;

(3) Restarting turbine engines in flight (including the effects of altitude);

(4) Fire, decompression, and similar emergencies;

(5) Ditching (including the procedures based on the requirements of §§ 25.801, 25.807(d), 25.1411, and 25.1415 (a) through (e));

(6) Use of ice protection equipment;

(7) Use of fuel jettisoning equipment, including any operating precautions relevant to the use of the system;

(8) Operation in turbulence for turbine powered airplanes (including recommended turbulence penetration airspeeds, flight peculiarities, and special control instructions);

(9) Restoring a deployed thrust reverser intended for ground operation only to the forward thrust position in flight or continuing flight and landing with the thrust reverser in any position except forward thrust; and

(10) Disconnecting the battery from its charging source, if compliance is shown with § 25.1353(c) (6) (ii) or (c) (6) (iii).

(b) Information identifying each operating condition in which the fuel system independence prescribed in § 25.953 is necessary for safety must be furnished, toegther with instructions for placing the fuel system in a configuration used to show compliance with that section.

(c) The buffet onset envelopes determined under § 25.251 must be furnished. The buffet onset envelopes presented may reflect the center of gravity at which the airplane is normally loaded during cruise if corrections for the effect of different center of gravity locations are furnished.

[(d) Information must be furnished which indicates that when the fuel quantity indicator reads "zero" in level flight, any fuel remaining in the fuel tank cannot be used safely in flight.

[(e) Information on the total quantity of usable fuel for each fuel tank must be furnished.]

§ 25.1587 Performance information.

(a) Each Airplane Flight Manual must contain information to permit conversion of the indicated temperature to free air temperature if other than a free air temperature indicator is used to comply with the requirements of § 25.1303(a) (1).

(b) Each Airplane Flight Manual must contain the performance information computed under the applicable provisions of this Part (including §§ 25.115, 25.123, and 25.125 for the weights, altitudes, temperatures, wind components, and runway gradients, as applicable) within the operational limits of the airplane, and must contain the following:

(1) The conditions under which the performance information was obtained, including the speeds associated with the performance information.

(2) V_S determined in accordance with § 25.103.

(3) The following performance information (determined by extrapolation and computed for the range of weights between the maximum landing and maximum takeoff weights):

(i) Climb in the landing configuration.

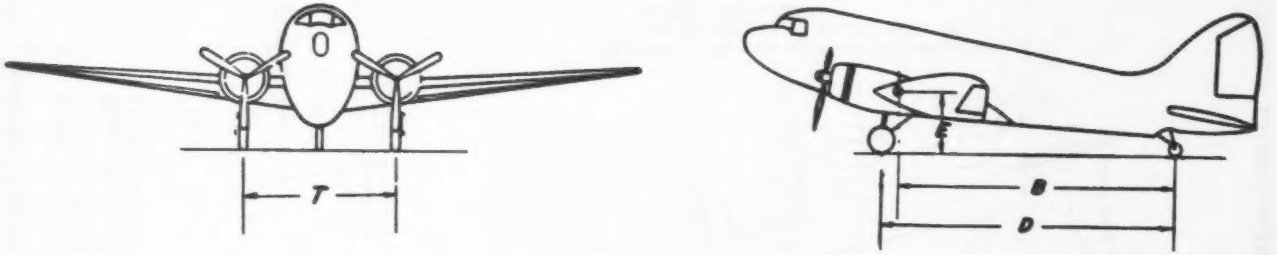
(ii) Climb in the approach configuration.

(iii) Landing distance.

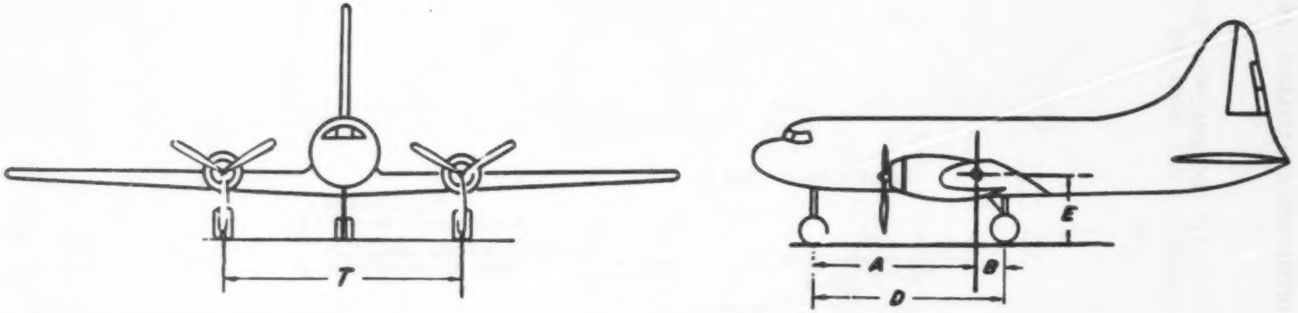
(4) Procedures established under §§ 25.101(f), (g), and (h) that are related to the limitations and information required by § 25.1533 and by this paragraph. These procedures must be in the form of guidance material, including any relevant limitations or information.

(5) An explanation of significant or unusual flight or ground handling characteristics of the airplane.

Appendix A



TAIL WHEEL TYPE



NOSE WHEEL TYPE

FIGURE 1—Basic landing gear dimension data.

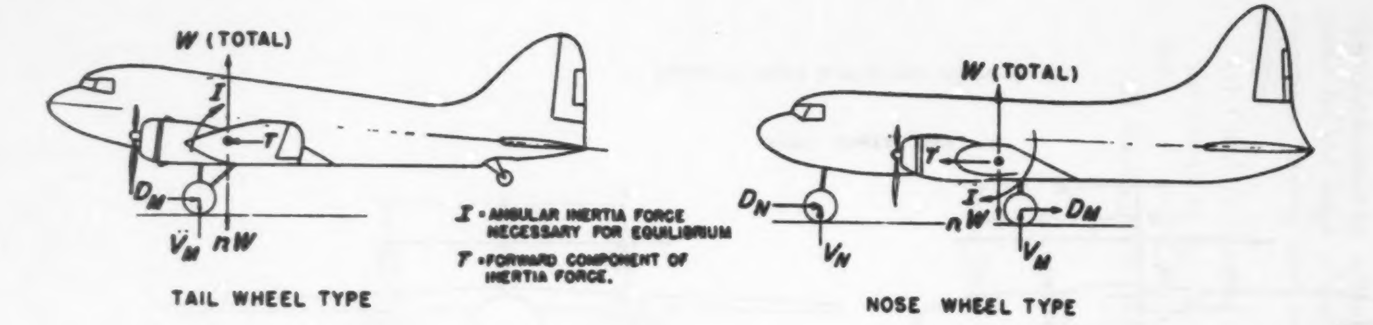

W (TOTAL)
I
T
D_M
V_M
nW
I = ANGULAR INERTIA FORCE NECESSARY FOR EQUILIBRIUM
T = FORWARD COMPONENT OF INERTIA FORCE.
TAIL WHEEL TYPE
W (TOTAL)
T
I
D_N
nW
D_M
V_N
V_M
NOSE WHEEL TYPE

FIGURE 2—Level landing.

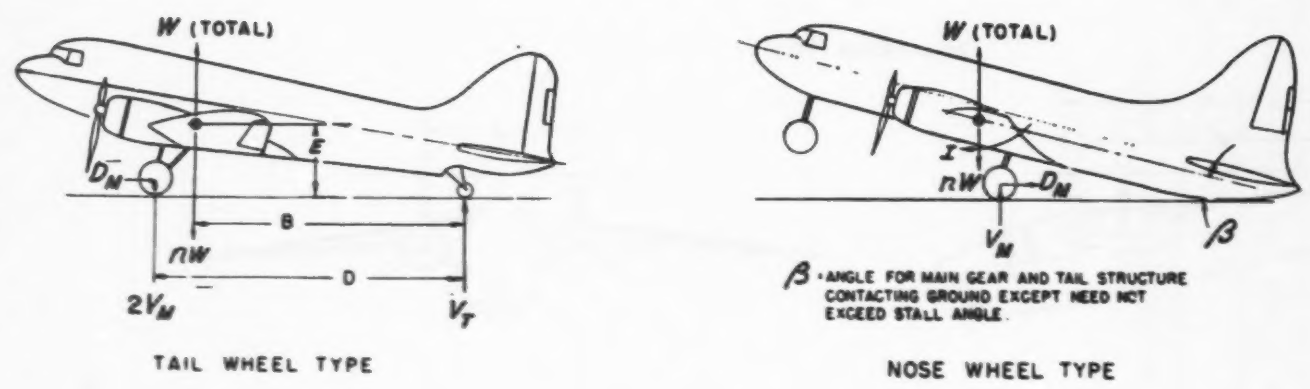

W (TOTAL)
E
D_M
B
nW
D
$2V_M$
V_T
TAIL WHEEL TYPE
W (TOTAL)
I
nW
D_M
V_M
β
β = ANGLE FOR MAIN GEAR AND TAIL STRUCTURE CONTACTING GROUND EXCEPT NEED NOT EXCEED STALL ANGLE.
NOSE WHEEL TYPE

FIGURE 3—Tail-down landing.

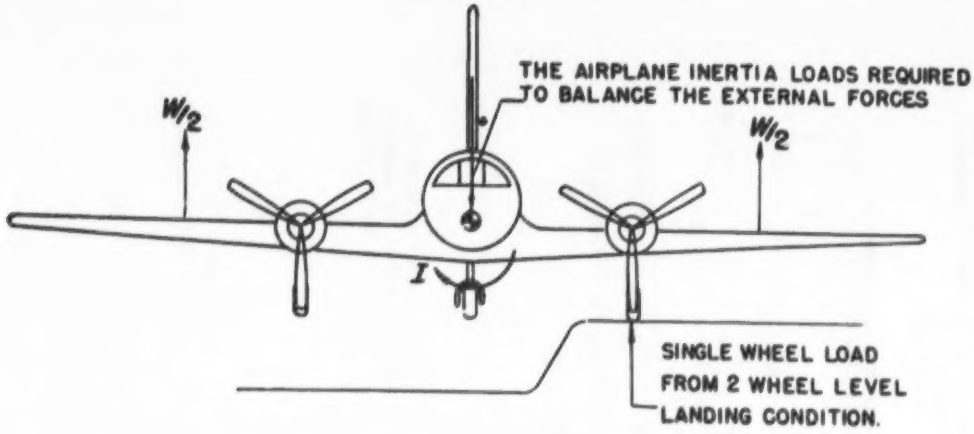

THE AIRPLANE INERTIA LOADS REQUIRED TO BALANCE THE EXTERNAL FORCES
W/2
W/2
I
SINGLE WHEEL LOAD FROM 2 WHEEL LEVEL LANDING CONDITION.
NOSE OR TAIL WHEEL TYPE

FIGURE 4—One-wheel landing.

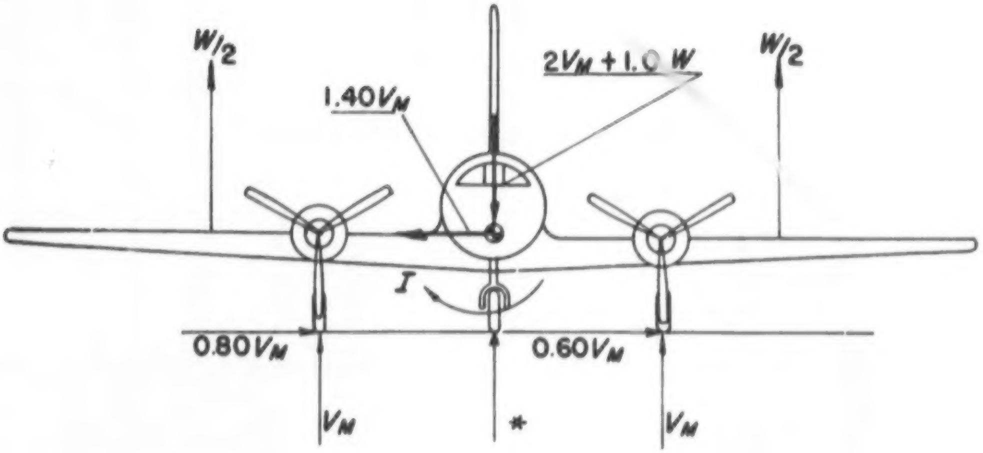

W/2
W/2
1.40V_M
2V_M + 1.0 W
I
0.80V_M
0.60V_M
V_M
*
V_M
V_M = ONE-HALF THE MAXIMUM VERTICAL GROUND REACTION OBTAINED AT EACH MAIN GEAR IN THE LEVEL LANDING CONDITIONS.
* NOSE GEAR GROUND REACTION = 0
NOSE OR TAIL WHEEL TYPE AIRPLANE IN LEVEL ALTITUDE

FIGURE 5—Lateral drift landing.

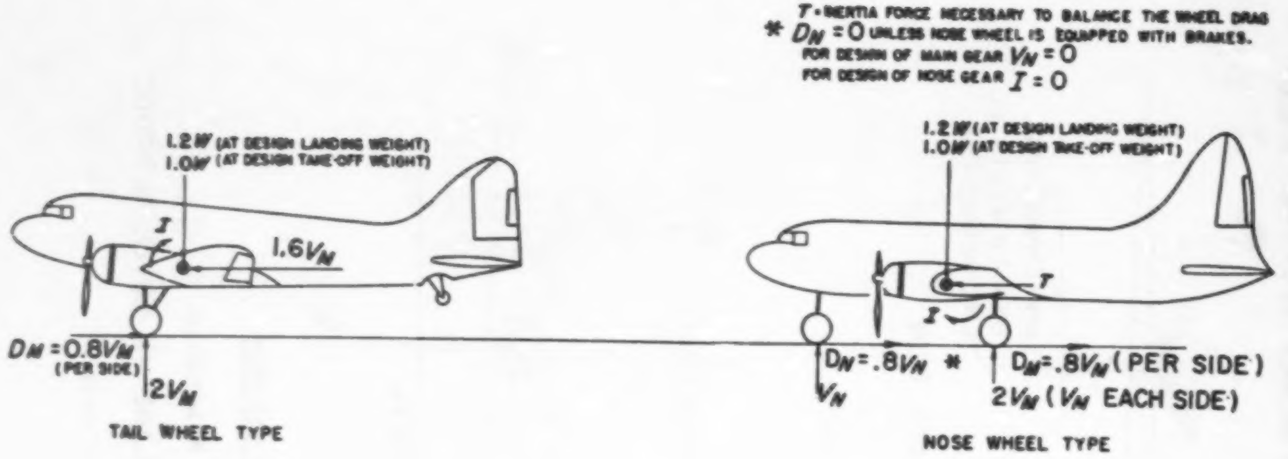

T = INERTIA FORCE NECESSARY TO BALANCE THE WHEEL DRAG
* D_N = 0 UNLESS NOSE WHEEL IS EQUIPPED WITH BRAKES.
FOR DESIGN OF MAIN GEAR V_N = 0
FOR DESIGN OF NOSE GEAR I = 0
1.2W (AT DESIGN LANDING WEIGHT)
1.0W (AT DESIGN TAKE-OFF WEIGHT)
I
1.6V_M
D_M = 0.8V_M (PER SIDE)
2V_M
TAIL WHEEL TYPE
1.2W (AT DESIGN LANDING WEIGHT)
1.0W (AT DESIGN TAKE-OFF WEIGHT)
T
I
D_N = .8V_N *
V_N
D_M = .8V_M (PER SIDE)
2V_M (V_M EACH SIDE)
NOSE WHEEL TYPE

Figure 6—Braked roll.

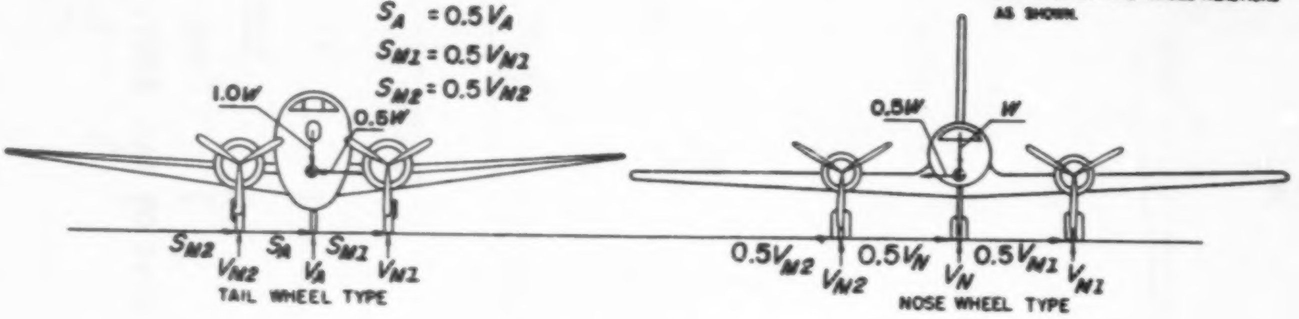
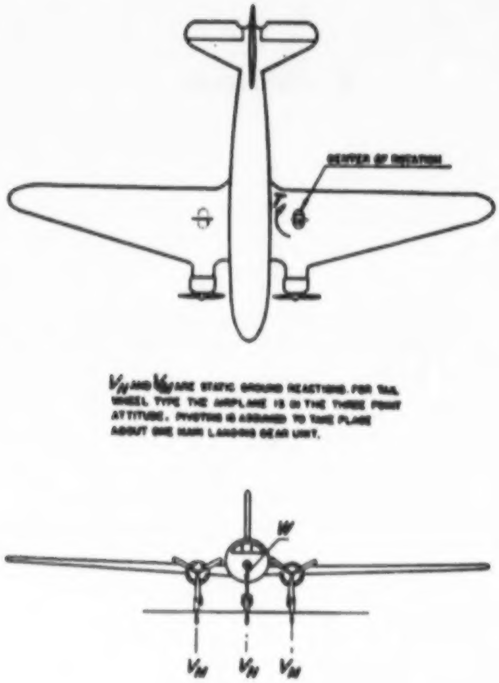

S_A = 0.5V_A
S_{M1} = 0.5V_{M1}
S_{M2} = 0.5V_{M2}
1.0W
0.5W
S_{M2}
V_{M2}
S_A
V_A
S_{M1}
V_{M1}
TAIL WHEEL TYPE
THE AIRPLANE INERTIA FACTORS AT CENTER OF GRAVITY ARE COMPLETELY BALANCED BY THE WHEEL REACTIONS AS SHOWN.
0.5W
W
0.5V_{M2}
V_{M2}
0.5V_N
V_N
0.5V_{M1}
V_{M1}
NOSE WHEEL TYPE

Figure 7—Ground turning.


CENTER OF ROTATION
T
W
V_M
V_N
V_M

V_N AND V_M ARE STATIC GROUND REACTIONS. FOR TAIL WHEEL TYPE THE AIRPLANE IS IN THE THREE POINT ATTITUDE. PIVOTING IS ASSUMED TO TAKE PLACE ABOUT ONE MAIN LANDING GEAR UNIT.

FIGURE 8—Pivoting, nose or tail wheel type.

Appendix B

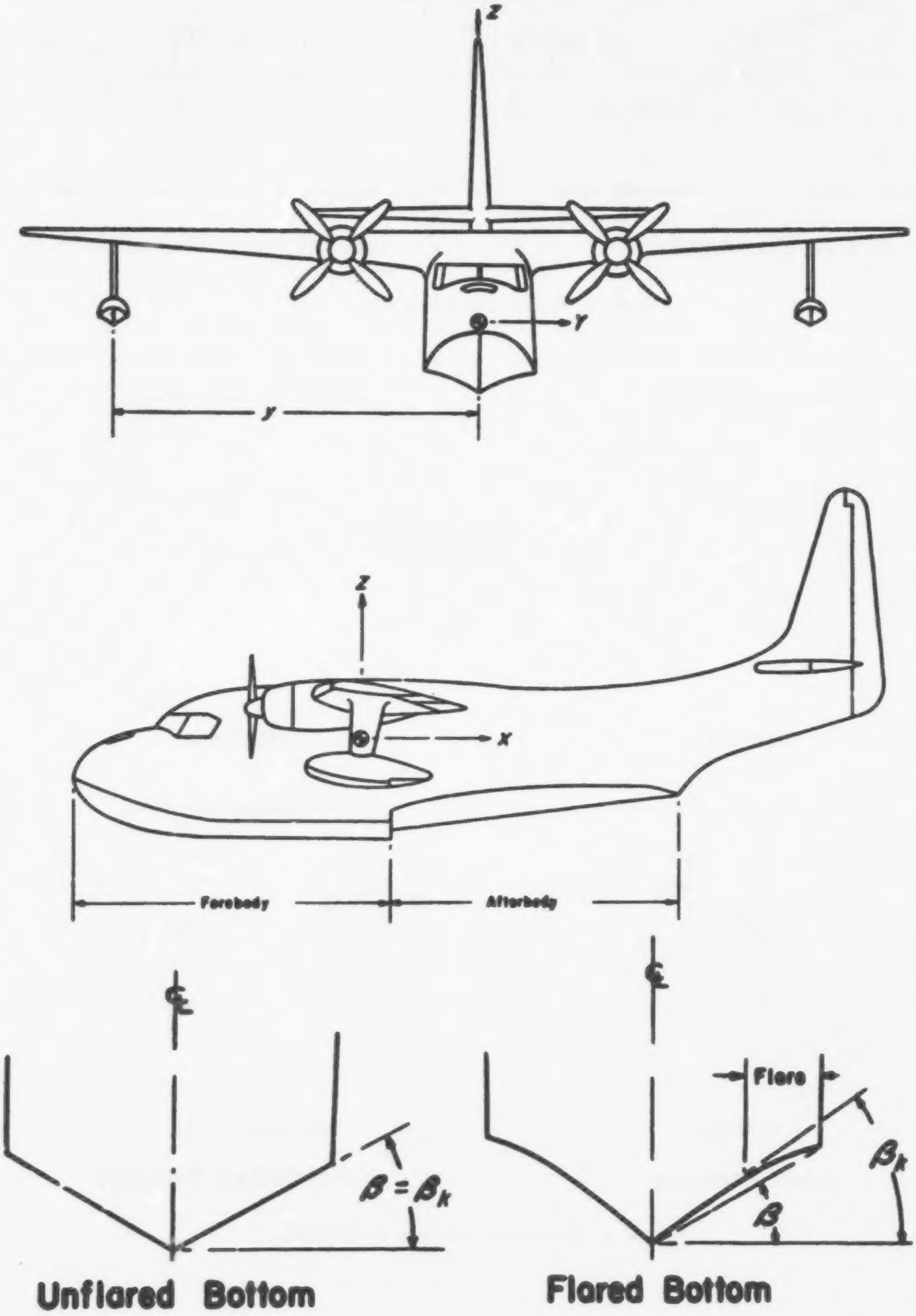

z
Y
y
z
X
Forebody
Afterbody
℄
℄
Flare
$\beta = \beta_k$
β
β_k
Unflared Bottom
Flared Bottom

FIGURE 1—Pictorial definition of angles, dimensions, and directions on a seaplane.

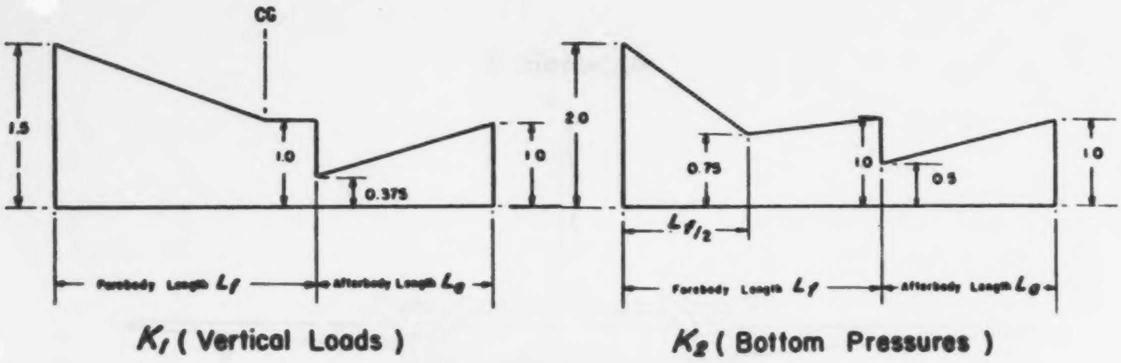

CG
1.5
1.0
0.375
1.0
Forebody Length L_f
Afterbody Length L_a
K_1 (Vertical Loads)
2.0
0.75
$L_{f/2}$
1.0
0.5
1.0
Forebody Length L_f
Afterbody Length L_a
K_2 (Bottom Pressures)

FIGURE 2—Hull station weighing factor.

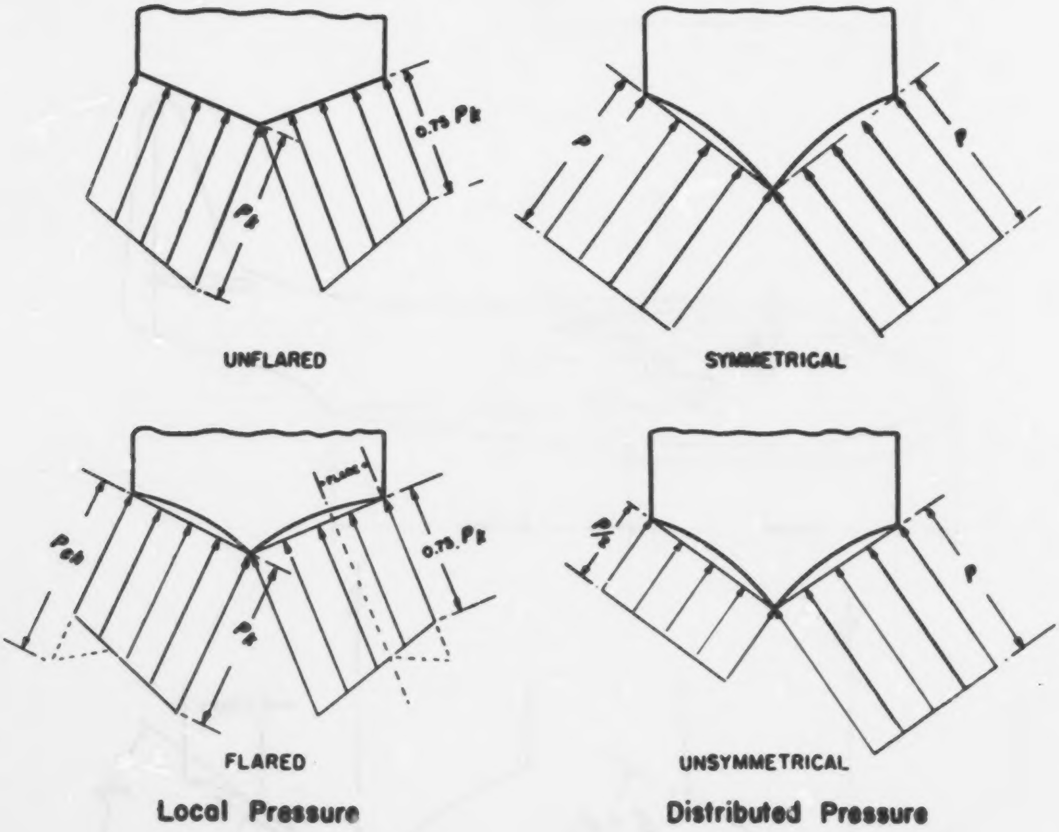

0.75 Pk
Pk
UNFLARED
P
P
SYMMETRICAL
Pch
FLARE
0.75 Pk
Pk
FLARED
P/2
P
UNSYMMETRICAL
Local Pressure
Distributed Pressure

FIGURE 3—Transverse pressure distributions.

Appendix C

(a) *Continuous maximum icing.* The maximum continuous intensity of atmospheric icing conditions (continuous maximum icing) is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables as shown in Figure 1 of this Appendix. The limiting icing envelope in terms of altitude and temperature is given in Figure 2 of this Appendix. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from Figures 1 and 2. The cloud liquid water content for continuous maximum icing conditions of a horizontal extent, other than 17.4 nautical miles, is determined by the value of liquid water content of Figure 1, multiplied by the appropriate factor from Figure 3 of this Appendix.

(b) *Intermittent maximum icing.* The intermittent maximum intensity of atmospheric icing conditions (intermittent maximum icing) is defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the inter-relationship of these three variables as shown in Figure 4 of this Appendix. The limiting icing envelope in terms of altitude and temperature is given in Figure 5 of this Appendix. The inter-relationship of cloud liquid water content with drop diameter and altitude is determined from Figures 4 and 5. The cloud liquid water content for intermittent maximum icing conditions of a horizontal extent, other than 2.6 nautical miles, is determined by the value of cloud liquid water content of Figure 4 multiplied by the appropriate factor in Figure 6 of this Appendix.

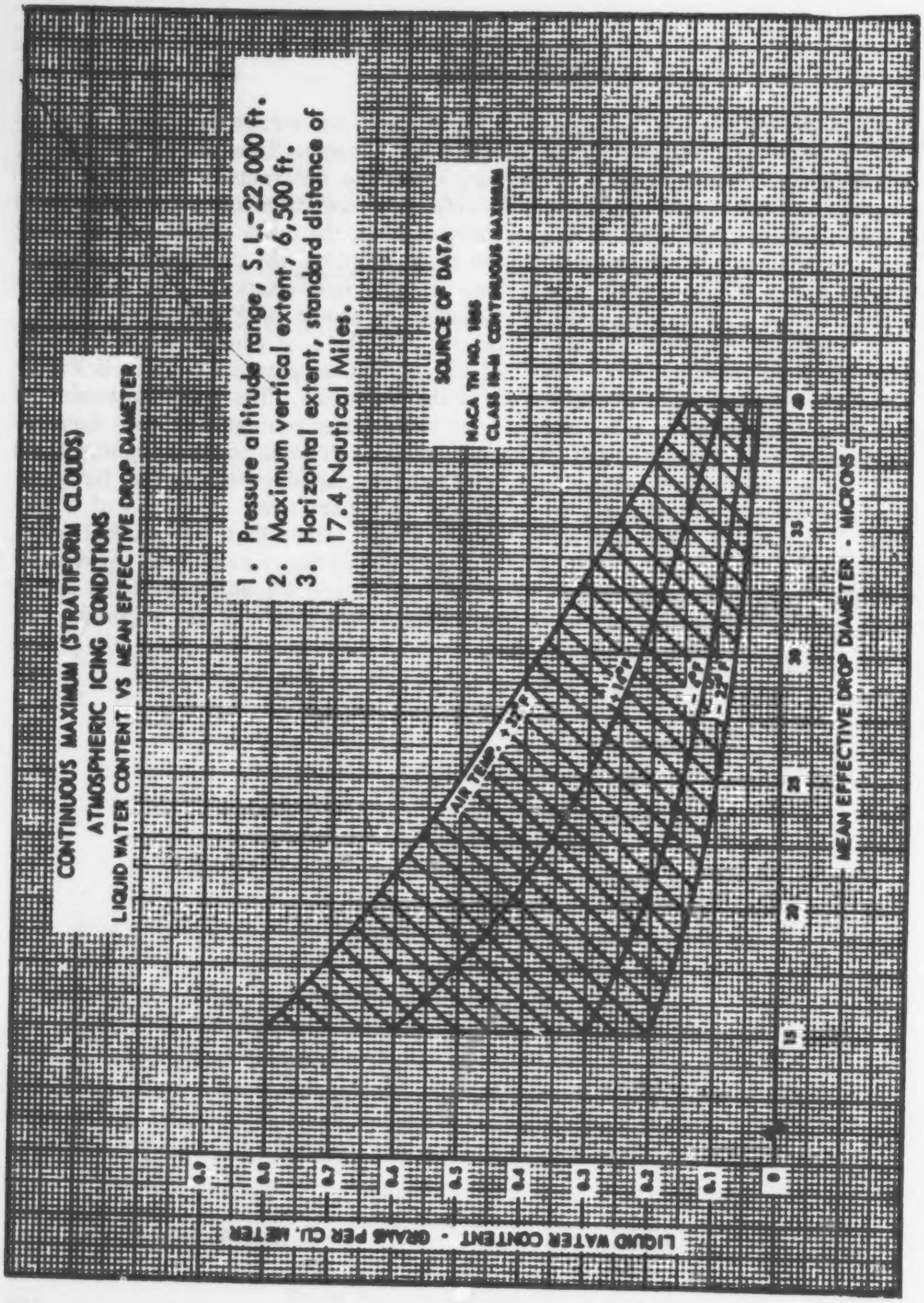

CONTINUOUS MAXIMUM (STRATIFORM CLOUDS)
ATMOSPHERIC ICING CONDITIONS
LIQUID WATER CONTENT VS MEAN EFFECTIVE DROP DIAMETER
1. Pressure altitude range, S.L.-22,000 ft.
2. Maximum vertical extent, 6,500 ft.
3. Horizontal extent, standard distance of 17.4 Nautical Miles.
SOURCE OF DATA
NACA TN NO. 1855
CLASS III-M CONTINUOUS MAXIMUM
AIR TEMP. +32°F
+14°F
-4°F
-22°F
LIQUID WATER CONTENT - GRAMS PER CU. METER
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
MEAN EFFECTIVE DROP DIAMETER - MICRONS
15
20
25
30
35
40

FIGURE 1.

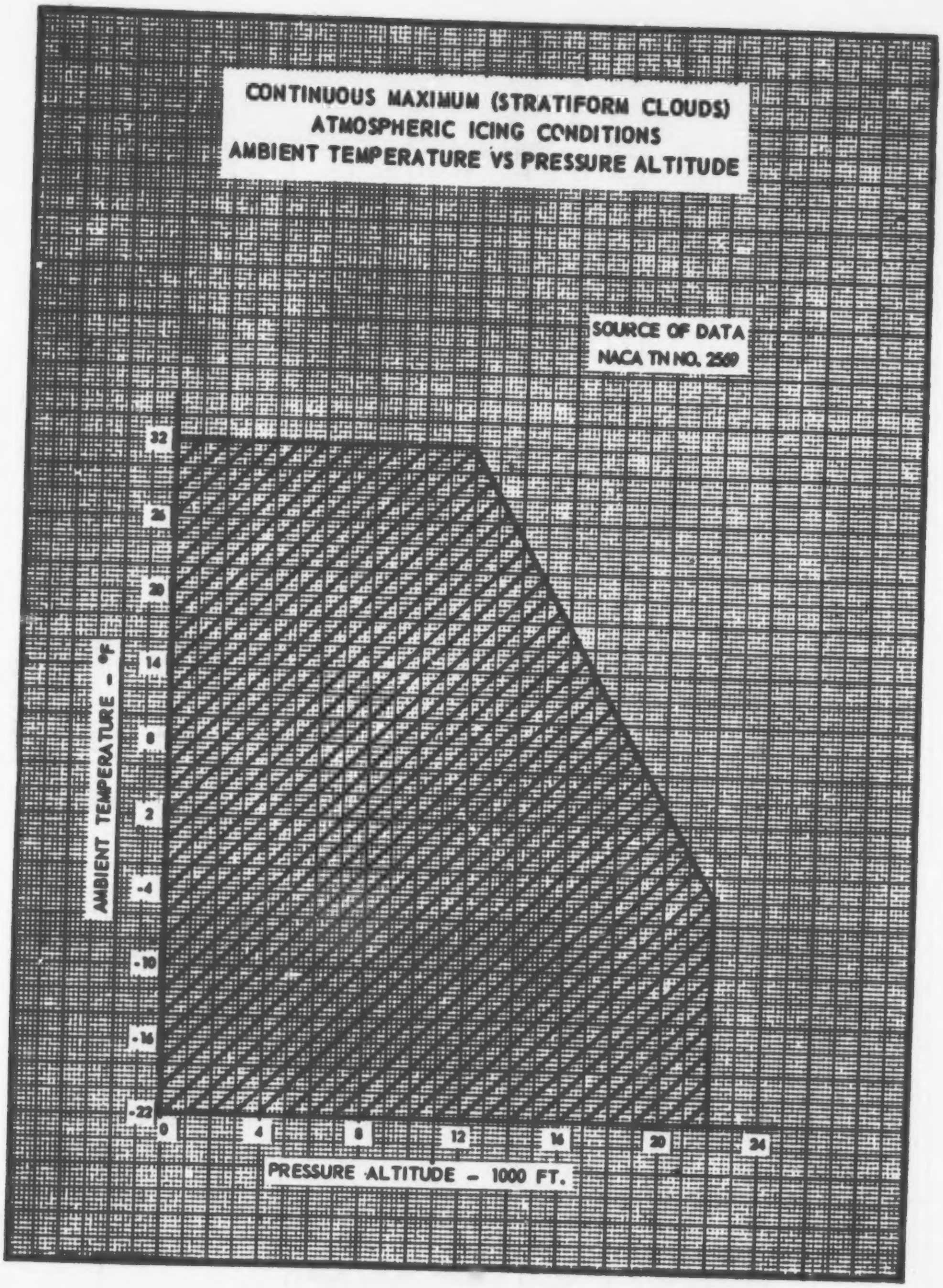

CONTINUOUS MAXIMUM (STRATIFORM CLOUDS)
ATMOSPHERIC ICING CONDITIONS
AMBIENT TEMPERATURE VS PRESSURE ALTITUDE
SOURCE OF DATA
NACA TN NO. 2569
AMBIENT TEMPERATURE – °F
32
26
20
14
8
2
-4
-10
-16
-22
0
4
8
12
16
20
24
PRESSURE ALTITUDE – 1000 FT.

FIGURE 2.

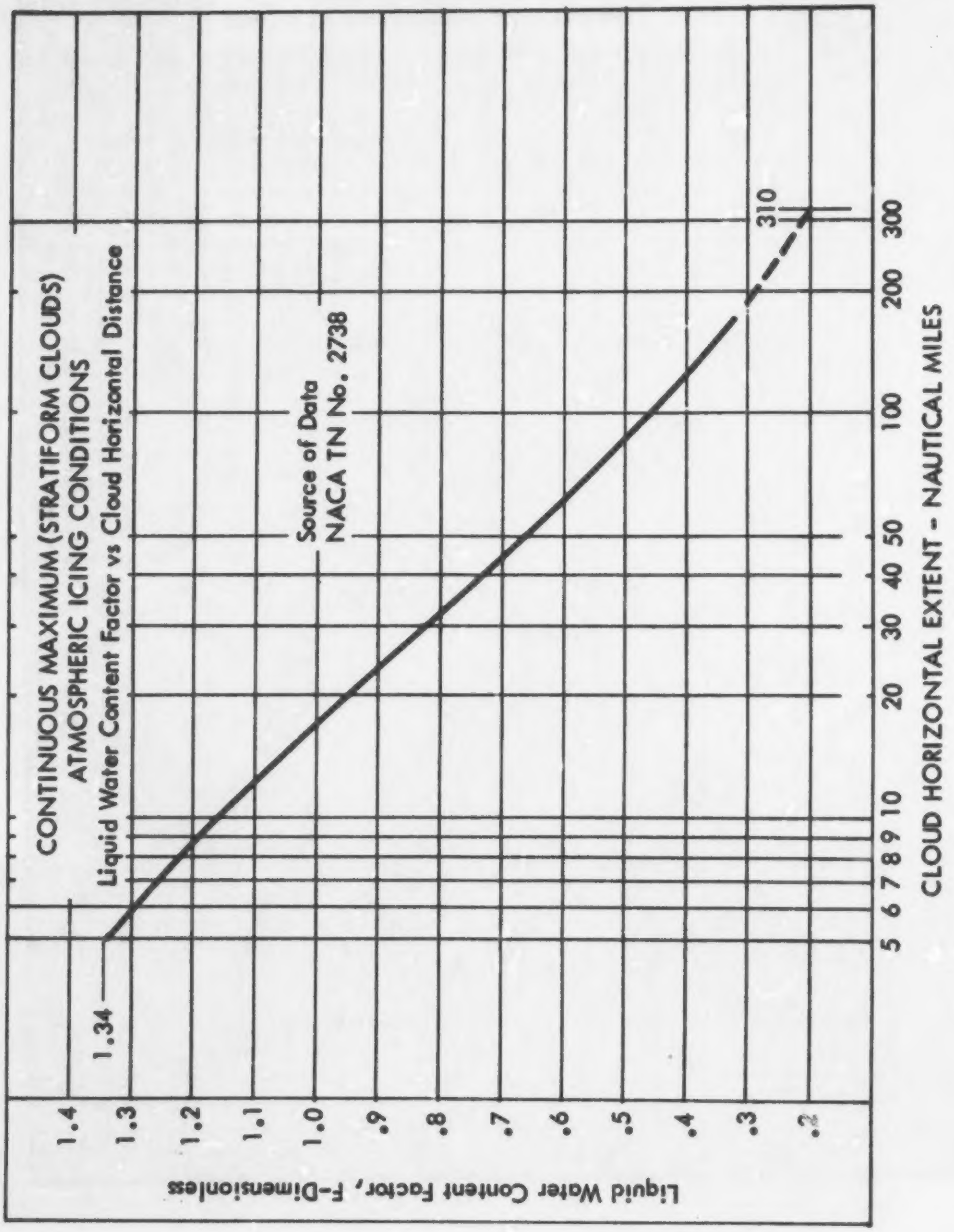

CONTINUOUS MAXIMUM (STRATIFORM CLOUDS)
ATMOSPHERIC ICING CONDITIONS
Liquid Water Content Factor vs Cloud Horizontal Distance
Source of Data
NACA TN No. 2738
1.34
310
Liquid Water Content Factor, F-Dimensionless
1.4
1.3
1.2
1.1
1.0
.9
.8
.7
.6
.5
.4
.3
.2
5
6
7
8
9
10
20
30
40
50
100
200
300
CLOUD HORIZONTAL EXTENT - NAUTICAL MILES

FIGURE 3.

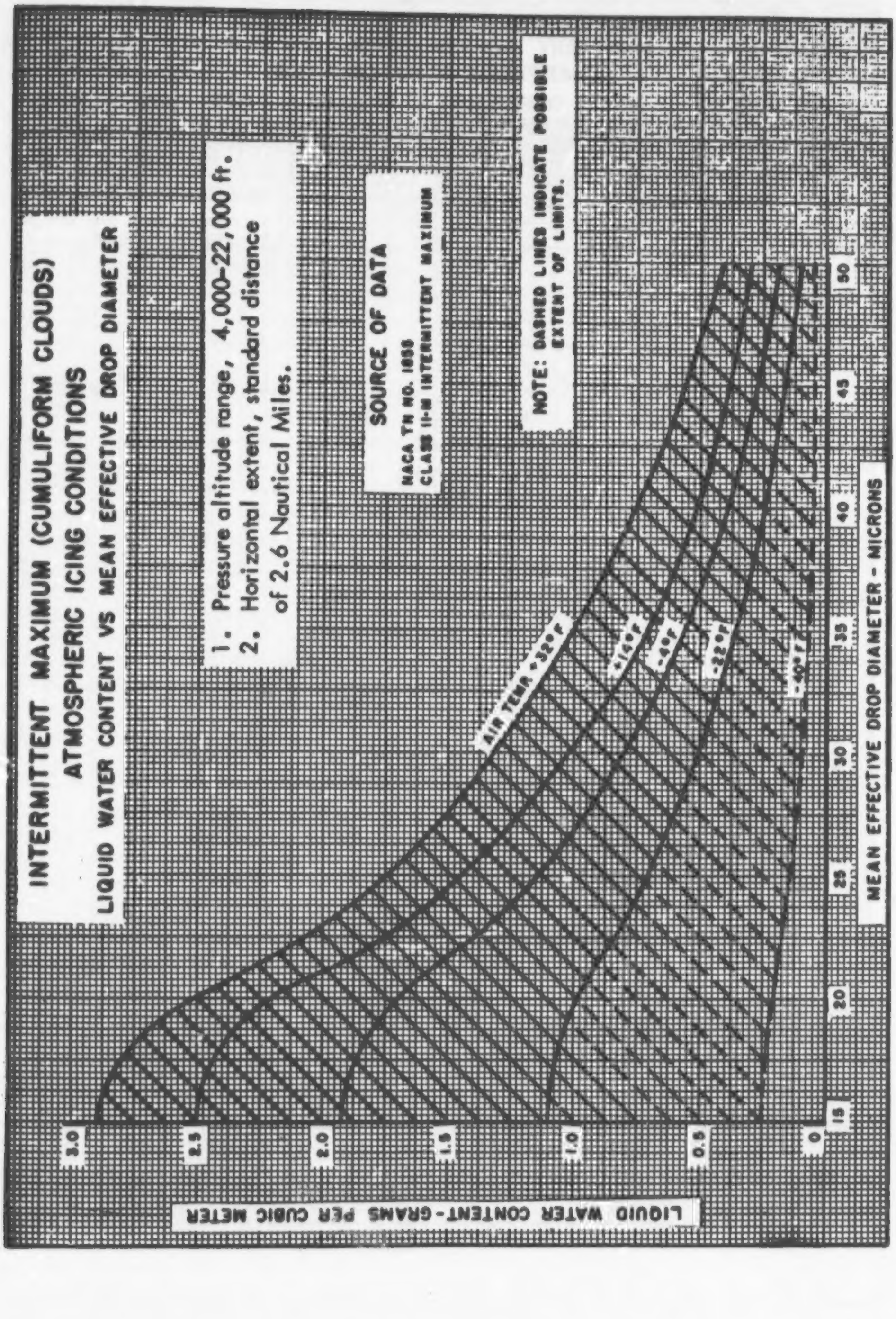

INTERMITTENT MAXIMUM (CUMULIFORM CLOUDS)
ATMOSPHERIC ICING CONDITIONS
LIQUID WATER CONTENT VS MEAN EFFECTIVE DROP DIAMETER
1. Pressure altitude range, 4,000-22,000 ft.
2. Horizontal extent, standard distance of 2.6 Nautical Miles.
SOURCE OF DATA
NACA TN NO. 1855
CLASS II-M INTERMITTENT MAXIMUM
NOTE: DASHED LINES INDICATE POSSIBLE EXTENT OF LIMITS.
AIR TEMP. +32°F
+14°F
-4°F
-22°F
-40°F
LIQUID WATER CONTENT-GRAMS PER CUBIC METER
0
0.5
1.0
1.5
2.0
2.5
3.0
15
20
25
30
35
40
45
50
MEAN EFFECTIVE DROP DIAMETER - MICRONS

FIGURE 4.

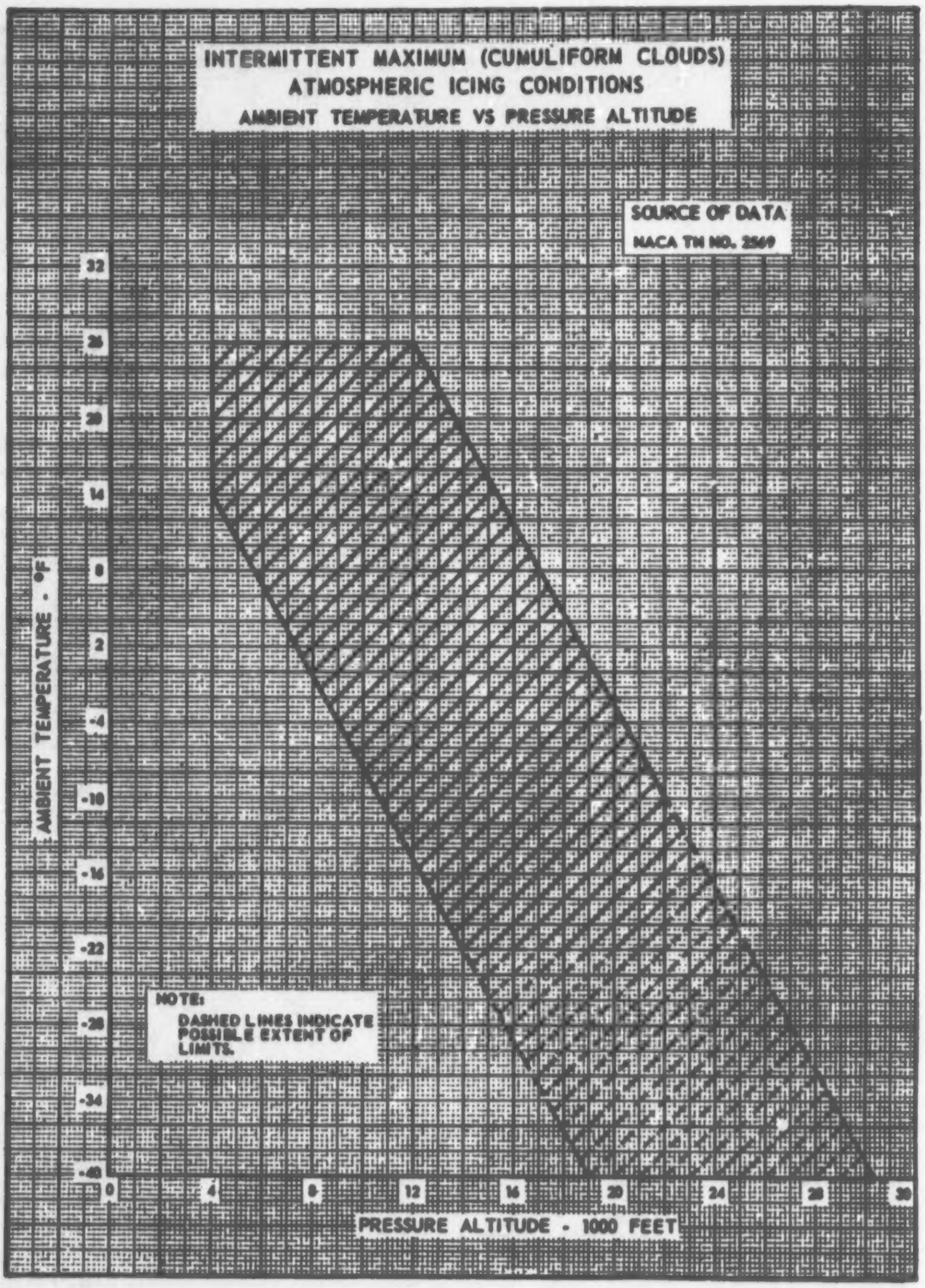

INTERMITTENT MAXIMUM (CUMULIFORM CLOUDS)
ATMOSPHERIC ICING CONDITIONS
AMBIENT TEMPERATURE VS PRESSURE ALTITUDE
SOURCE OF DATA
NACA TN NO. 2569
AMBIENT TEMPERATURE - °F
32
26
20
14
8
2
-4
-10
-16
-22
-28
-34
-40
0
4
8
12
16
20
24
28
32
PRESSURE ALTITUDE - 1000 FEET
NOTE:
DASHED LINES INDICATE POSSIBLE EXTENT OF LIMITS.

Figure 5.

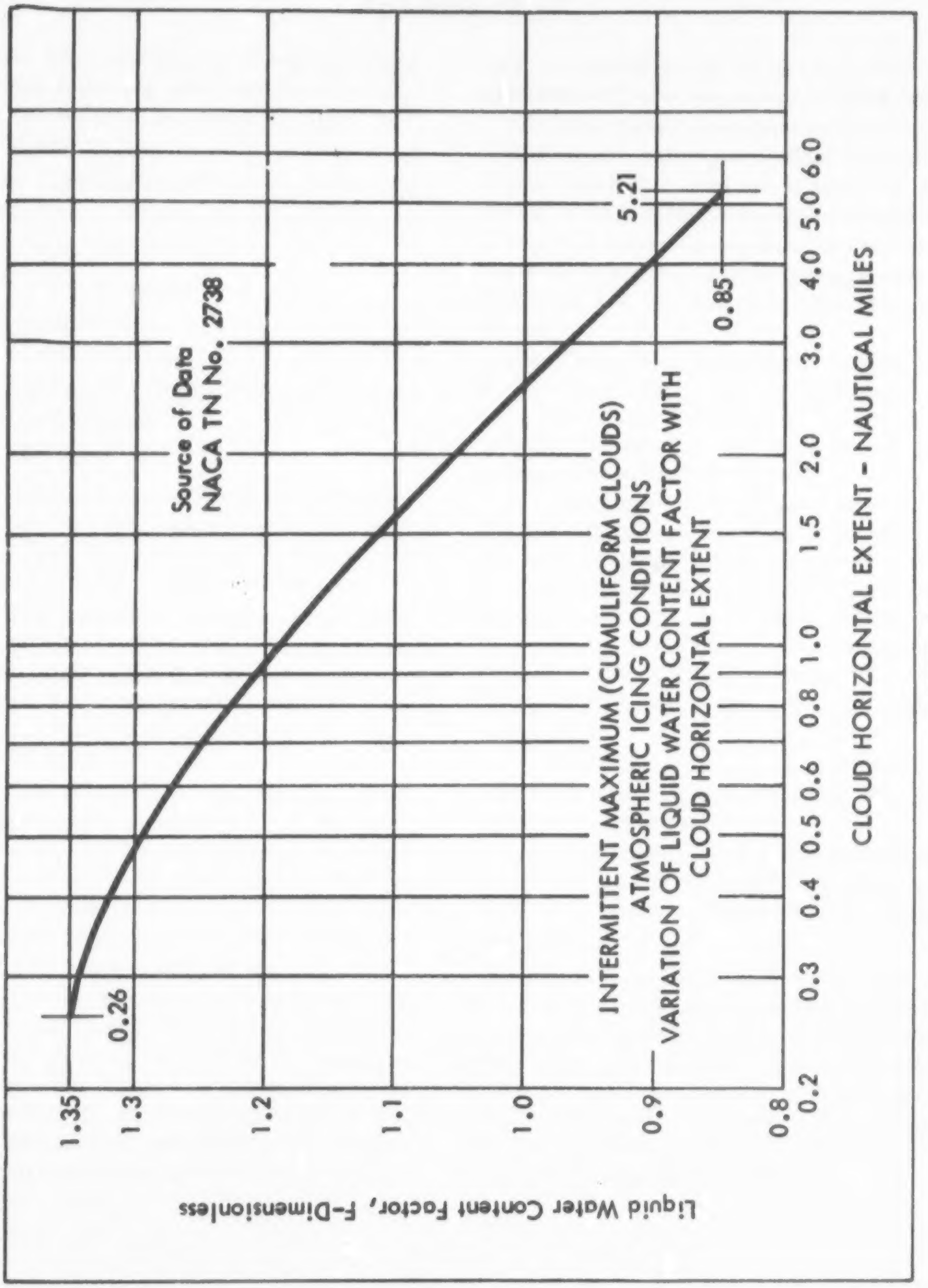

INTERMITTENT MAXIMUM (CUMULIFORM CLOUDS)
ATMOSPHERIC ICING CONDITIONS
VARIATION OF LIQUID WATER CONTENT FACTOR WITH
CLOUD HORIZONTAL EXTENT
Source of Data
NACA TN No. 2738
Liquid Water Content Factor, F-Dimensionless
CLOUD HORIZONTAL EXTENT - NAUTICAL MILES
1.35
1.3
1.2
1.1
1.0
0.9
0.8
0.2
0.3
0.4
0.5
0.6
0.8
1.0
1.5
2.0
3.0
4.0
5.0
6.0
0.26
5.21
0.85

FIGURE 6.

Appendix D

Criteria for determining minimum flight crew. The following are considered by the FAA in determining the minimum flight crew under § 25.1523:

a. *Basic workload functions.* The following basic workload functions are considered:

(1) Flight path control.

(2) Collision avoidance.

(3) Navigation.

(4) Communications.

(5) Operation and monitoring of aircraft engines and systems.

(6) Command decisions.

b. *Workload factors.* The following workload factors are considered significant when analyzing and demonstrating workload for minimum flight crew determination:

(1) The accessibility, ease ,and simplicity of operation of all necessary flight, power, and equipment controls, including emergency fuel shutoff valves, electrical controls, electronic controls, pressurization system controls, and engine controls.

(2) The accessibility and conspicuity of all necessary instruments and failure warning devices such as fire warning, electrical system malfunction, and other failure or caution indicators. The extent to which such instruments or devices direct the proper corrective action is also considered.

(3) The number, urgency, and complexity of operating procedures with particular consideration given to the specific fuel management schedule imposed by center of gravity, structural or other considerations of an airworthiness nature, and to the ability of each engine to operate at all times from a single tank or source which is automatically replenished if fuel is also stored in other tanks.

(4) The degree and duration of concentrated mental and physical effort involved in normal operation and in diagnosing and coping with malfunctions and emergencies.

(5) The extent of required monitoring of the fuel, hydraulic, pressurization, electrical, electronic, deicing, and other systems while en route.

(6) The actions requiring a crewmember to be unavailable at his assigned duty station, including: observation of systems, emergency operation of any control, and emergencies in any compartment.

(7) The degree of automation provided in the aircraft systems to afford (after failures or malfunctions) automatic crossover or isolation of difficulties to minimize the need for flight crew action to guard against loss of hydraulic or electric power to flight controls or to other essential systems.

(8) The communications and navigation workload.

(9) The possibility of increased workload associated with any emergency that may lead to other emergencies.

(10) Incapacitation of a flight crewmember whenever the applicable operating rule requires a minimum flight crew of at least two pilots.

(c) *Kind of operation authorized.* The determination of the kind of operation authorized requires consideration of the operating rules under which the airplane will be operated. Unless an applicant desires approval for a more limited kind of operation, it is assumed that each airplane certificated under this Part will operate under IFR conditions.

Appendix E

I—Limited Weight Credit For Airplanes Equipped With Standby Power

(a) Each applicant for an increase in the maximum certificated takeoff and landing weights of an airplane equipped with a type-certificated standby power rocket engine may obtain an increase as specified in paragraph (b) if—

(1) The installation of the rocket engine has been approved and it has been established by flight test that the rocket engine and its controls can be operated safely and reliably at the increase in maximum weight; and

(2) The Airplane Flight Manual, or the placard, markings or manuals required in place thereof, set forth in addition to any other operating limitations the Administrator may require, the increased weight approved under this regulation and a prohibition against the operation of the airplane at the approved increased weight when—

(i) The installed standby power rocket engines have been stored or installed in excess of the time limit established by the manufacturer of the rocket engine (usually stenciled on the engine casing); or

(ii) The rocket engine fuel has been expended or discharged.

(b) The currently approved maximum takeoff and landing weights at which an airplane is certificated without a standby power rocket engine installation may be increased by an amount that does not exceed any of the following:

(1) An amount equal in pounds to 0.014 IN, where I is the maximum usable impulse in pounds-seconds available from each standby power rocket engine and N is the number of rocket engines installed.

(2) An amount equal to 5 percent of the maximum certificated weight approved in accordance with the applicable airworthiness regulations without standby power rocket engines installed.

(3) An amount equal to the weight of the rocket engine installation.

(4) An amount that, together with the currently approved maximum weight, would equal the maximum structural weight established for the airplane without standby rocket engines installed.

II—Performance Credit for Transport Category Airplanes Equipped With Standby Power

The Administrator may grant performance credit for the use of standby power on transport category airplanes. However, the performance credit applies only to the maximum certificated takeoff and landing weights, the takeoff distance, and the takeoff paths, and may not exceed that found by the Administrator to result in an overall level of safety in the takeoff, approach, and landing regimes of flight equivalent to that prescribed in the regulations under which the airplane was originally certificated without standby power. For the purposes of this Appendix, "standby power" is power or thrust, or both, obtained from rocket engines for a relatively short period and actuated only in cases of emergency. The following provisions apply:

(1) *Takeoff; general.* The takeoff data prescribed in §§ (2) and (3) must be determined at all weights and altitudes, and at ambient temperatures if applicable, at which performance credit is to be applied.

(2) *Takeoff path.*

(a) The one-engine-inoperative takeoff path with standby power in use must be determined

best copy available

in accordance with the performance requirements of the applicable airworthiness regulations.

(b) The one-engine-inoperative takeoff path (excluding that part where the airplane is on or just above the takeoff surface) determined in accordance with paragraph (a) of this section must lie above the one-engine-inoperative takeoff path without standby power at the maximum takeoff weight at which all of the applicable airworthiness requirements are met. For the purpose of this comparison, the flight path is considered to extend to at least a height of 400 feet above the takeoff surface.

(c) The takeoff path with all engines operating but without the use of standby power, must reflect a conservatively greater overall level of performance than the one-engine-inoperative takeoff path established in accordance with paragraph (a) of this section. The margin must be established by the Administrator to insure safe day-to-day operations, but in no case may it be less than 15 percent. The all-engines-operating takeoff path must be determined by a procedure consistent with that established in complying with paragraph (a) of this section.

(d) For reciprocating-engine-powered airplanes, the takeoff path to be scheduled in the Airplane Flight Manual must represent the one-engine-inoperative takeoff path determined in accordance with paragraph (a) of this section and modified to reflect the procedure (see § (6)) established by the applicant for flap retraction and attainment of the en route speed. The scheduled takeoff path must have a positive slope at all points of the airborne portion and at no point must it lie above the takeoff path specified in paragraph (a) of this section.

(3) *Takeoff distance.* The takeoff distance must be the horizontal distance along the one-engine-inoperative takeoff path determined in accordance with § (2)(a) from the start of the takeoff to the point where the airplane attains a height of 50 feet above the takeoff surface for reciprocating-engine-powered airplanes and a height of 35 feet above the takeoff surface for turbine-powered airplanes.

(4) *Maximum certificated takeoff weights.* The maximum certificated takeoff weights must be determined at all altitudes, and at ambient temperatures, if applicable, at which performance credit is to be applied and may not exceed the weights established in compliance with paragraphs (a) and (b) of this section.

(a) The conditions of § (2)(b) through (d) must be met at the maximum certificated takeoff weight.

(b) Without the use of standby power, the airplane must meet all of the en route requirements of the applicable airworthiness regulations under which the airplane was originally certificated. In addition, turbine-powered airplanes without the use of standby power must meet the final takeoff climb requirements prescribed in the applicable airworthiness regulations.

(5) *Maximum certificated landing weights.*

(a) The maximum certificated landing weights (one-engine-inoperative approach and all-engines-operating landing climb) must be determined at all altitudes, and at ambient temperatures if applicable, at which performance credit is to be applied and must not exceed that established in compliance with paragraph (b) of this section.

(b) The flight path, with the engines operating at the power or thrust, or both, appropriate to the airplane configuration and with standby power in use, must lie above the flight path without standby power in use at the maximum weight at which all of the applicable airworthiness requirements are met. In addition, the flight paths must comply with subparagraphs (i) and (ii) of this paragraph.

(i) The flight paths must be established without changing the appropriate airplane configuration.

(ii) The flight paths must be carried out for a minimum height of 400 feet above the point where standby power is actuated.

(6) *Airplane configuration, speed, and power and thrust; general.* Any change in the airplane's configuration, speed, and power

or thrust, or both, must be made in accordance with the procedures established by the applicant for the operation of the airplane in service and must comply with paragraphs (a) through (c) of this section. In addition, procedures must be established for the execution of balked landings and missed approaches.

(a) The Administrator must find that the procedure can be consistently executed in service by crews of average skill.

(b) The procedure may not involve methods or the use of devices which have not been proven to be safe and reliable.

(c) Allowances must be made for such time delays in the execution of the procedures as may be reasonably expected to occur during service.

(7) *Installation and operation; standby power.* The standby power unit and its installation must comply with paragraphs (a) and (b) of this section.

(a) The standby power unit and its installation must not adversely affect the safety of the airplane.

(b) The operation of the standby power unit and its control must have proven to be safe and reliable.

Appendix F

[Part I—An Acceptable Test Procedure for Showing Compliance with §§ 25.853, 25.855, and 25.1359]

(a) *Conditioning.* Specimens must be conditioned to 70° F., plus or minus 5°, and at 50 percent plus or minus 5 percent relative humidity until moisture equilibrium is reached or for 24 hours. Only one specimen at a time may be removed from the conditioning environment immediately before subjecting it to the flame.

(b) *Specimen configuration.* Except as provided for materials used in electrical wire and cable insulation and in small parts, materials must be tested either as a section cut from a fabricated part as installed in the airplane or as a specimen simulating a cut section, such as: a specimen cut from a flat sheet of the material or a model of the fabricated part. The specimen may be cut from any location in a fabricated part; however, fabricated units, such as sandwich panels, may not be separated for test. The specimen thickness must be no thicker than the minimum thickness to be qualified for use in the airplane, except that: (1) thick foam parts, such as seat cushions, must be tested in ½-inch thickness; (2) when showing compliance with § 25.853(b-3) for materials used in small parts that must be tested, the materials must be tested in no more than ⅛-inch thickness; (3) when showing compliance with § 25.1359(d) for materials used in electrical wire and cable insulation, the wire and cable specimens must be the same size as used in the airplane. In the case of fabrics, both the warp and fill direction of the weave must be tested to determine the most critical flammability condition. When performing the tests prescribed in paragraphs (d) through (e) of [Part I of this Appendix,] the specimen must be mounted in a metal frame so that; (1) in the vertical tests of paragraph (d), the two long edges and the upper edge are held securely; (2) in the horizontal test of paragraph (e), the two long edges and the edge away from the flame are held securely; (3) the exposed area of the specimen is at least 2 inches wide and 12 inches long, unless the actual size used in the airplane is smaller; and (4) the edge to which the burner flame is applied must not consist of the finished or protected edge of the specimen but must be representative of the actual cross-section of the material or part installed in the airplane. When performing the test prescribed in paragraph (f) of [Part I of this Appendix,] the specimen must be mounted in a metal frame so that all four edges are held securely and the exposed area of the specimen is at least 8 inches by 8 inches.

(c) *Apparatus.* Except as provided in paragraph (g) of [Part I of this Appendix,] tests must be conducted in a draft-free cabinet in accordance with Federal Test Method Standard 191 Method 5903 (revised Method 5902) for the vertical test, or Method 5906 for horizontal test (available from the General Services Administration, Business Service Center, Region 3, Seventh & D Streets, S.W., Washington, D.C. 20407) or other approved equivalent methods. Specimens which are too large for the cabinet must be tested in similar draft-free conditions.

(d) *Vertical test, in compliance with § 25.853(a) and (b).* A minimum of three specimens must be tested and the results averaged. For fabrics, the direction of weave corresponding to the most critical flammability conditions must be parallel to the longest dimension. Each specimen must be supported vertically. The specimen must be exposed to a Bunsen or Tirrill burner with a nominal ⅜-inch I.D. tube adjusted to give a flame of 1½ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. The lower edge of the specimen must be three-fourths inch above the top edge of the burner. The flame must be applied to the center line of the lower edge of the specimen. For materials covered by § 25.853(a), the flame must be applied for 60 seconds and then removed. For materials covered by § 25.853(b), the flame must be applied for 12 seconds and then removed. Flame time, burn length, and flaming time of drippings, if any, must be recorded. The burn length determined in accordance with paragraph (h) of [Part I of this Appendix] must be measured to the nearest one-tenth inch.

(e) *Horizontal test in compliance with § 25.853(b-2) and (b-3).* A minimum of three specimens must be tested and the results averaged. Each specimen must be supported horizontally. The exposed surface when installed in the aircraft must be face down for the test. The specimen must be exposed to a Bunsen burner or Tirrill burner with a nominal three-eights inch I.D. tube adjusted to give a flame of 1½ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. The specimen must be positioned so that the edge being tested is three-fourths of an inch above the top of, and on the center line of, the burner. The flame must be applied for 15 seconds and then removed. A minimum of 10 inches of the specimen must be used for timing purposes, approximately 1½ inches must burn before the burning front reaches the timing zone, and the average burn rate must be recorded.

(f) *Forty-five degree test, in compliance with § 25.855(a-1).* A minimum of three specimens must be tested and the results averaged. The specimens must be supported at an angle of 45° to a horizontal surface. The exposed surface when installed in the aircraft must be face down for the test. The specimens must be exposed to a Bunsen or Tirrill burner with a nominal three-eighths inch I.D. tube adjusted to give a flame of 1½ inches in height. The minimum flame temperature measured by a calibrated thermocouple pyrometer in the center of the flame must be 1550° F. Suitable precautions must be taken to avoid drafts. One-third of the flame must contact the material at the center of the specimen and must be applied for 30 seconds and then removed. Flame time, glow time, and whether the flame penetrates (passes through) the specimen must be recorded.

(g) *Sixty degree test in compliance with § 25.1359(d).* A minimum of three specimens of each wire specification (make and size) must be tested. The specimen of wire or cable (including insulation) must be placed at an angle of 60° with the horizontal in the cabinet specified in paragraph (c) of [Part I of this Appendix] with the cabinet door open during the test or must be placed within a chamber approximately 2 feet high x 1 foot x 1 foot, open at the top and at one vertical side (front), and which allows sufficient flow of air for complete combustion, but which is free from drafts. The specimen must be parallel to and approximately 6 inches from the front of the chamber. The lower end of the specimen must be held rigidly clamped. The upper end of the specimen must pass over a pulley or rod and must have an appropriate weight attached to it so that the specimen is held tautly throughout the flammability test. The test specimen span between lower clamp and upper pulley or rod must be 24 inches and must be marked 8 inches from the lower end to indicate the central point for flame application. A flame from a Bunsen or Tirrill burner must be applied for 30 seconds at the test mark. The burner must be mounted underneath the test mark on the specimen, perpendicular to the specimen and at an angle of 30° to the vertical plane of the specimen. The burner must have a nominal bore of 3/8 inch, and must be adjusted to provide a 3-inch high flame with an inner cone approximately one-third of the flame height. The minimum temperature of the hottest portion of the flame, as measured with a calibrated thermocouple pyrometer, may not be less than 1750°F. The burner must be positioned so that the hottest portion of the flame is applied to the test mark on the wire. Flame time, burn length, and flaming time of drippings, if any, must be recorded. The burn length determined in accordance with paragraph (h) of [Part I of this Appendix] must be measured to the nearest 1/10-inch. Breaking of the wire specimens is not considered a failure.

(h) *Burn length.* Burn length is the distance from the original edge to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or embrittlement, but not including areas sooted, stained, warped, or discolored, nor areas where material has shrunk or melted away from the heat source.

[Part II—Flammability of Seat Cushions

[(a) *Criteria for Acceptance.* Each seat cushion must meet the following criteria:

[(1) At least three sets of seat bottom and seat back cushion specimens must be tested.

[(2) If the cushion is constructed with a fire blocking material, the fire blocking material must completely enclose the cushion foam core material.

[(3) Each specimen tested must be fabricated using the principal components (i.e., foam core, flotation material, fire blocking material, if used, and dress covering) and assembly processes (representative seams and closures) intended for use in the production articles. If a different material combination is used for the back cushion than for the bottom cushion, both material combinations must be tested as complete specimen sets, each set consisting of a back cushion specimen and a bottom cushion specimen. If a cushion, including outer dress covering, is demonstrated to meet the requirements of this Appendix using the oil burner test, the dress covering of that cushion may be replaced with a similar dress covering provided the burn length of the replacement covering, as determined by the test specified in § 25.853(b), does not exceed the corresponding burn length of the dress covering used on the cushion subjected to the oil burner test.

[(4) For at least two-thirds of the total number of specimen sets tested, the burn length from the burner must not reach the side of the cushion opposite the burner. The burn length must not exceed 17 inches. Burn length is the perpendicular distance from the inside edge of the seat frame closest to the burner to the farthest evidence of damage to the test specimen due to flame impingement, including areas of partial or complete consumption, charring, or embrittlement, but not including areas sooted, stained, warped, or discolored, or areas where material has shrunk or melted away from the heat source.

[(5) The average percentage weight loss must not exceed 10 percent. Also, at least two-thirds of the total number of specimen sets tested must not exceed 10 percent weight loss. All droppings falling from the cushions and mounting stand are to be discarded before the after-test weight is determined. The percentage weight loss for a specimen set is the weight of the specimen set before testing less the weight of the specimen set after testing expressed as the percentage of the weight before testing.

[(b) *Test Conditions.* Vertical air velocity should average 25 fpm ± 10 fpm at the top of the back seat cushion. Horizontal air velocity should be below 10 fpm just above the bottom seat cushion. Air velocities should be measured with the ventilation hood operating and the burner motor off.

[(c) *Test Specimens.*

[(1) For each test, one set of cushion specimens representing a seat bottom and seat back cushion must be used.

[(2) The seat bottom cushion specimen must be 18 ± ⅛ inches (457 ± 3 mm) wide by 20 ± ⅛ inches (508 ± 3 mm) deep by 4 ± ⅛ inches (102 ± 3 mm) thick, exclusive of fabric closures and seam overlap.

[(3) The seat back cushion specimen must be 18 ± ⅛ inches (432 ± 3 mm) wide by 25 ± ⅛ inches (635 ± 3 mm) high by 2 ± ⅛ inches (51 ± 3 mm) thick, exclusive of fabric closures and seam overlap.

[(4) The specimens must be conditioned at 70±5°F (21±2°C) 55%±10% relative humidity for at least 24 hours before testing.

[(d) *Test Apparatus.* The arrangement of the test apparatus is shown in Figures 1 through 5 and must include the components described in this section. Minor details of the apparatus may vary, depending on the model burner used.

[(1) *Specimen Mounting Stand.* The mounting stand for the test specimens consists of steel angles, as shown in Figure 1. The length of the mounting stand legs is 12±⅛ inches (305±3 mm). The mounting stand must be used for mounting the test specimen seat bottom and seat back, as shown in Figure 2. The mounting stand should also include a suitable drip pan lined with aluminum foil, dull side up.

[(2) *Test Burner.* The burner to be used in testing must—

[(i) Be a modified gun type;

[(ii) Have an 80-degree spray angle nozzle nominally rated for 2.25 gallons/hour at 100 psi;

[(iii) Have a 12-inch (305 mm) burner cone installed at the end of the draft tube, with an opening 6 inches (152 mm) high and 11 inches (280 mm) wide, as shown in Figure 3; and

[(iv) Have a burner fuel pressure regulator that is adjusted to deliver a nominal 2.0 gallon/hour of #2 Grade kerosene or equivalent required for the test.

[Burner models which have been used successfully in testing are the Lennox Model OB-32, Carlin Model 200 CRD, and Park Model DPL 3400. FAA published reports pertinent to this type of burner are: (1) Powerplant Engineering Report No. 3A, Standard Fire Test Apparatus and Procedure for Flexible Hose Assemblies, dated March 1978; and (2) Report No. DOT/FAA/RD/76/213, Reevaluation of Burner Characteristics for Fire Resistance Tests, dated January 1977.

[(3) *Calorimeter.*

[(i) The calorimeter to be used in testing must be a 0–15.0 BTU/ft^2-sec. 0–17.0 W/cm^2) calorimeter, accurate ±3%, mounted in a 6-inch by 12-inch (152 by 305 mm) by ¾-inch (19 mm) thick calcium silicate insulating board which is attached to a steel angle bracket for placement in the test stand during burner calibration, as shown in Figure 4.

[(ii) Because crumbling of the insulating board with service can result in misalignment of the calorimeter, the calorimeter must be monitored and the mounting shimmed, as necessary, to ensure that the calorimeter face is flush with the exposed plane of the insulating board in a plane parallel to the exit of the test burner cone.

[(4) *Thermocouples.* The seven thermocouples to be used for testing must be 1/16 to ⅛-inch metal sheathed, ceramic packed, type K, grounded thermocouples with a nominal 22 to 30 American wire gage (AWG)-size conductor. The seven thermocouples must be attached to a steel angle bracket to form a thermocouple rake for placement in the test stand during burner calibration, as shown in Figure 5.

[(5) *Apparatus Arrangement.* The test burner must be mounted on a suitable stand to position the exit of the burner cone a distance of 4±⅛ inches (102±3 mm) from one side of the specimen mounting stand. The burner stand should have the capability of allowing the burner to be swung away from the specimen mounting stand during warmup periods.

[(6) *Data Recording.* A recording potentiometer or other suitable calibrated instrument with an appropriate range must be used to measure and record the outputs of the calorimeter and the thermocouples.

[(7) *Weight Scale.* Weighing Device—A device must be used that with proper procedures may determine the before and after test weights of each set of seat cushion specimens within 0.02 pound (9 grams). A continuous weighing system is preferred.

[(8) *Timing Device.* A stopwatch or other device (calibrated to ±1 second) must be used to measure the time of application of the burner flame and self-extinguishing time or test duration.

[(e) *Preparation of Apparatus.* Before calibration, all equipment must be turned on and the burner fuel must be adjusted as specified in paragraph (d) (2).

[(f) *Calibration.* To ensure the proper thermal output of the burner, the following test must be made:

[(1) Place the calorimeter on the test stand as shown in Figure 4 at a distance of 4±⅛ inches (102±3 mm) from the exit of the burner cone.

[(2) Turn on the burner, allow it to run for 2 minutes for warmup, and adjust the burner air intake damper to produce a reading of 10.5±0.5 BTU/ft^2-sec. (11.9±0.6 w/cm^2) on the calorimeter to ensure steady state conditions have been achieved. Turn off the burner.

[(3) Replace the calorimeter with the thermocouple rake (Figure 5).

[(4) Turn on the burner and ensure that the thermocouples are reading 1900±100°F (1038±38°C) to ensure steady state conditions have been achieved.

[(5) If the calorimeter and thermocouples do not read within range, repeat steps in paragraphs 1 through 4 and adjust the burner air intake damper until the proper readings are obtained. The thermocouple rake and the calorimeter should be used frequently to maintain and record calibrated test parameters. Until the specific apparatus has demonstrated consistency, each test should be calibrated. After consistency has been confirmed, several tests may be conducted with the pre-test calibration before and a calibration check after the series.

[(g) *Test Procedure.* The flammability of each set of specimens must be tested as follows:

[(1) Record the weight of each set of seat bottom and seat back cushion specimens to be tested to the nearest 0.02 pound (9 grams).

[(2) Mount the seat bottom and seat back cushion test specimens on the test stand as shown in Figure 2, securing the seat back cushion specimen to the test stand at the top.

[(3) Swing the burner into position and ensure that the distance from the exit of the burner cone to the side of the seat bottom cushion specimen is 4±⅛inches (102±3 mm).

[(4) Swing the burner away from the test position. Turn on the burner and allow it to run for 2 minutes to provide adequate warmup of the burner cone and flame stabilization.

[(5) To begin the test, swing the burner into the test position and simultaneously start the timing device.

[(6) Expose the seat bottom cushion specimen to the burner flame for 2 minutes and then turn off the burner. Immediately swing the burner away from the test position. Terminate test 7 minutes after initiating cushion exposure to the flame by use of a gaseous extinguishing agent (i.e., Halon or CO$_2$).

[(7) Determine the weight of the remains of the seat cushion specimen set left on the mounting stand to the nearest 0.02 pound (9 grams) excluding all droppings.

[(h) *Test Report.* With respect to all specimen sets tested for a particular seat cushion for which testing of compliance is performed, the following information must be recorded:

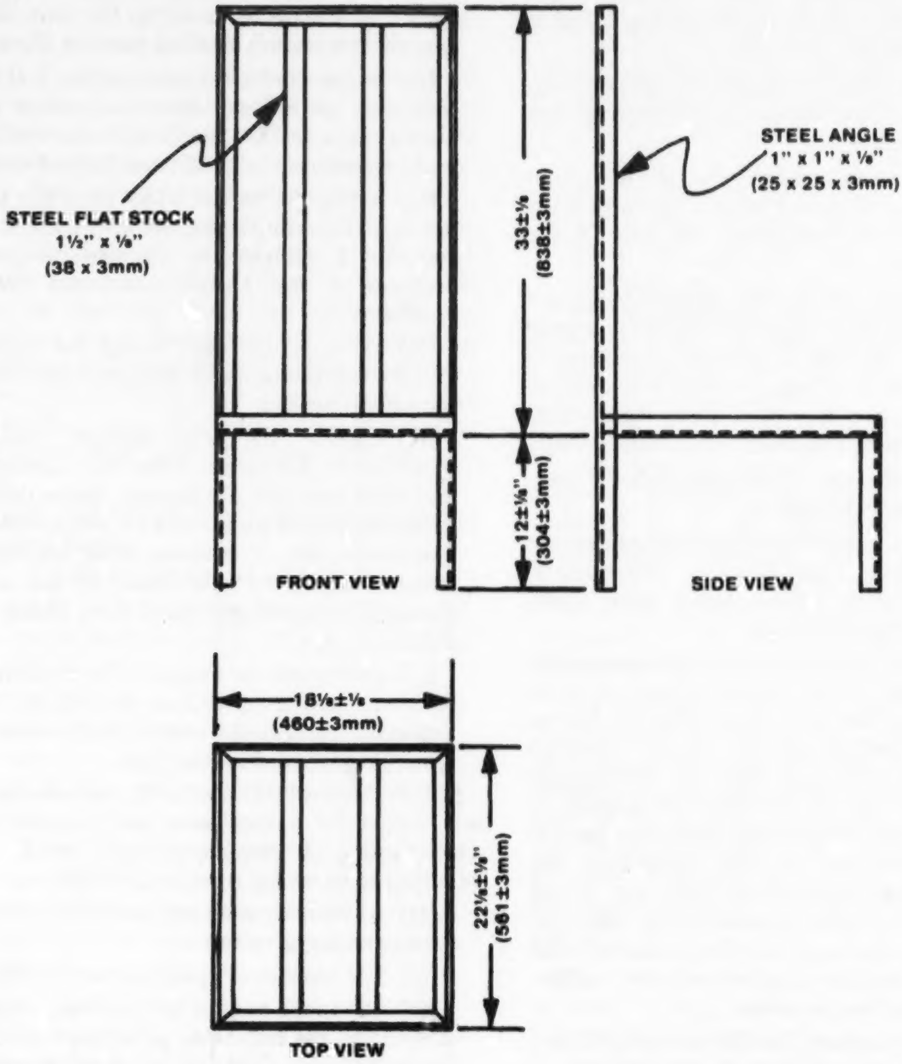
[(1) An identification and description of the specimens being tested.

[(2) The number of specimen sets tested.

[(3) The initial weight and residual weight of each set, the calculated percentage weight loss of each set, and the calculated average percentage weight loss for the total number of sets tested.

[(4) The burn length for each set tested.]

[


STEEL FLAT STOCK
1½" x ⅛"
(38 x 3mm)
STEEL ANGLE
1" x 1" x ⅛"
(25 x 25 x 3mm)
33±⅛
(838±3mm)
12±⅛"
(304±3mm)
FRONT VIEW
SIDE VIEW
18⅛±⅛
(460±3mm)
22⅛±⅛"
(561±3mm)
TOP VIEW

NOTE:
ALL JOINTS WELDED
FLAT STOCK BUTT WELDED
ALL MEASUREMENTS INSIDE

FIGURE 1

]

[

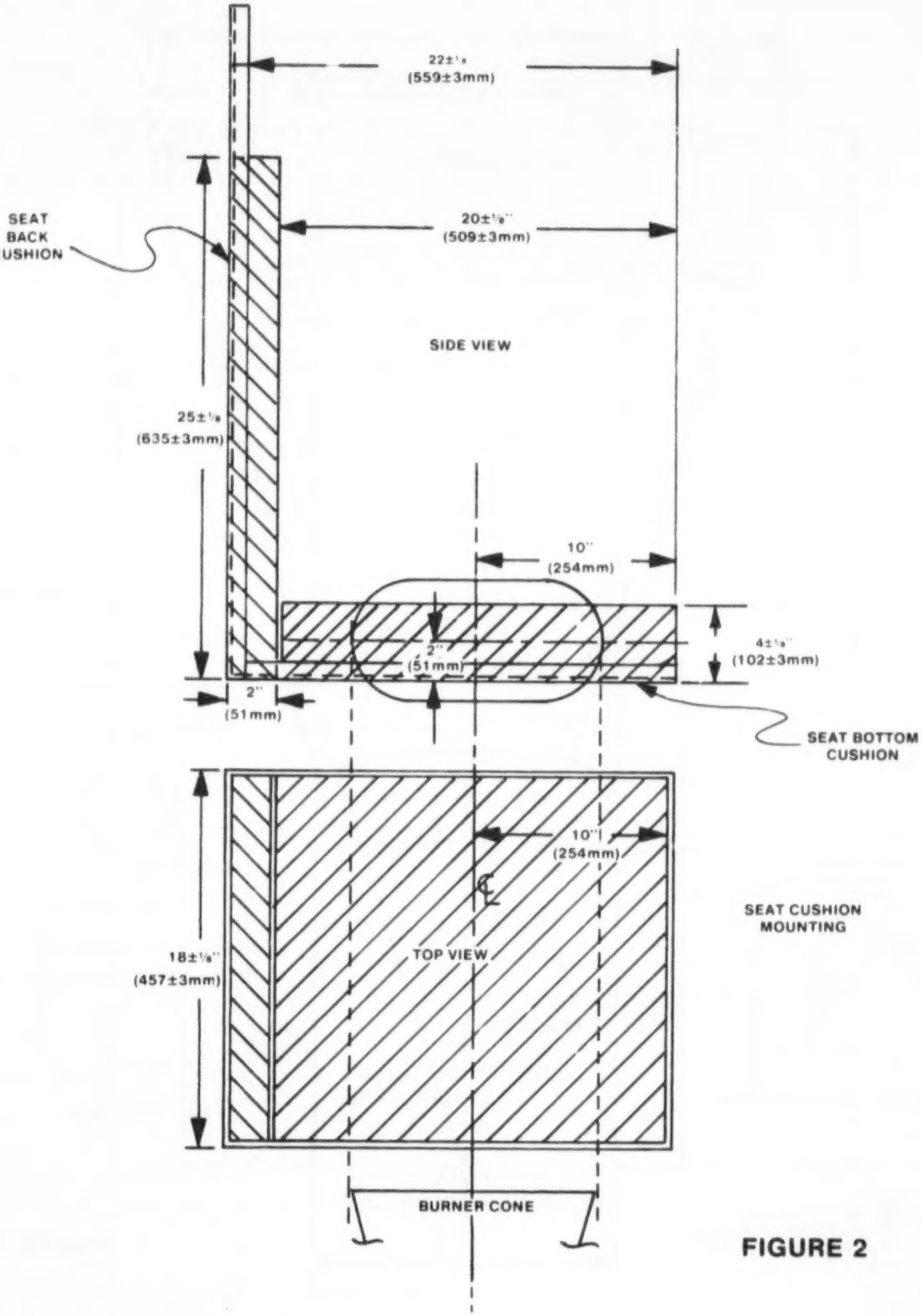

22±1/8"
(559±3mm)
SEAT
BACK
CUSHION
20±1/8"
(509±3mm)
SIDE VIEW
25±1/8"
(635±3mm)
10"
(254mm)
2"
(51mm)
4±1/8"
(102±3mm)
2"
(51mm)
SEAT BOTTOM
CUSHION
10"
(254mm)
℄
SEAT CUSHION
MOUNTING
18±1/8"
(457±3mm)
TOP VIEW
BURNER CONE

FIGURE 2

]

[

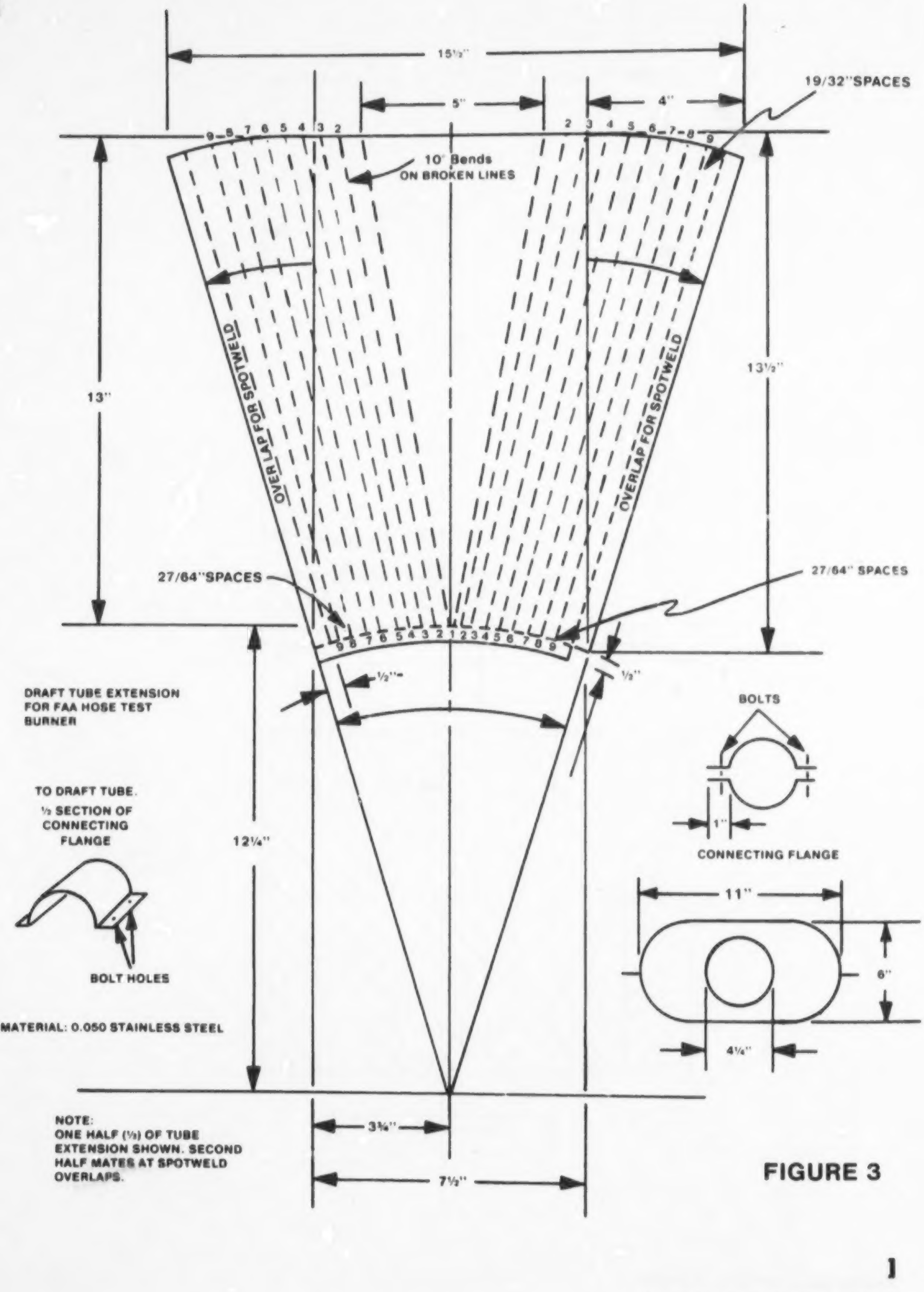
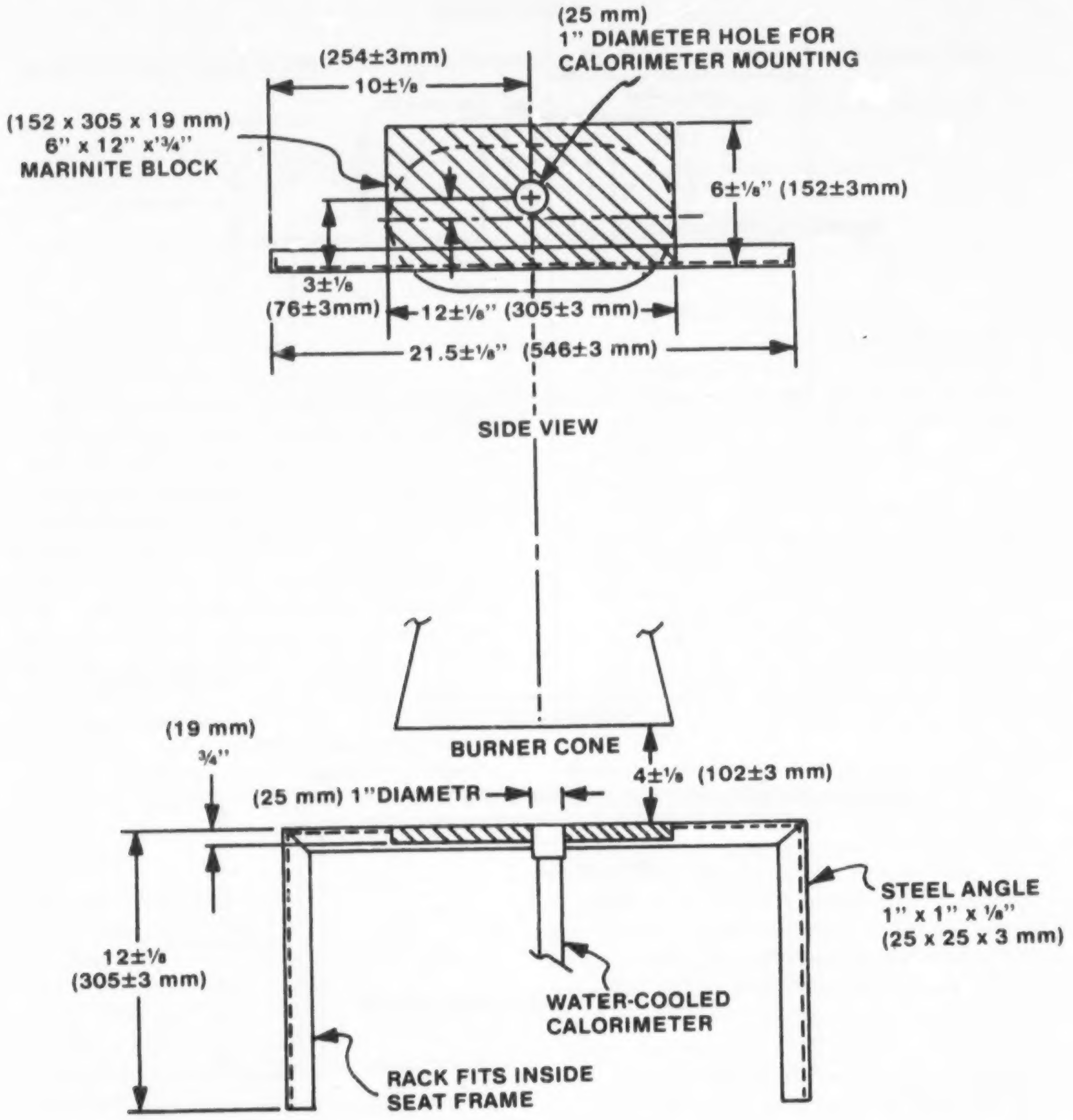

15½"
5"
4"
19/32"SPACES
9 8 7 6 5 4 3 2
2 3 4 5 6 7 8 9
10° Bends
ON BROKEN LINES
13"
13½"
OVERLAP FOR SPOTWELD
OVERLAP FOR SPOTWELD
27/64"SPACES
27/64" SPACES
9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9
½"
½"
DRAFT TUBE EXTENSION
FOR FAA HOSE TEST
BURNER
BOLTS
1"
CONNECTING FLANGE
TO DRAFT TUBE.
½ SECTION OF
CONNECTING
FLANGE
12¼"
BOLT HOLES
11"
6"
4¼"
MATERIAL: 0.050 STAINLESS STEEL
NOTE:
ONE HALF (½) OF TUBE
EXTENSION SHOWN. SECOND
HALF MATES AT SPOTWELD
OVERLAPS.
3¾"
7½"

FIGURE 3

]

[

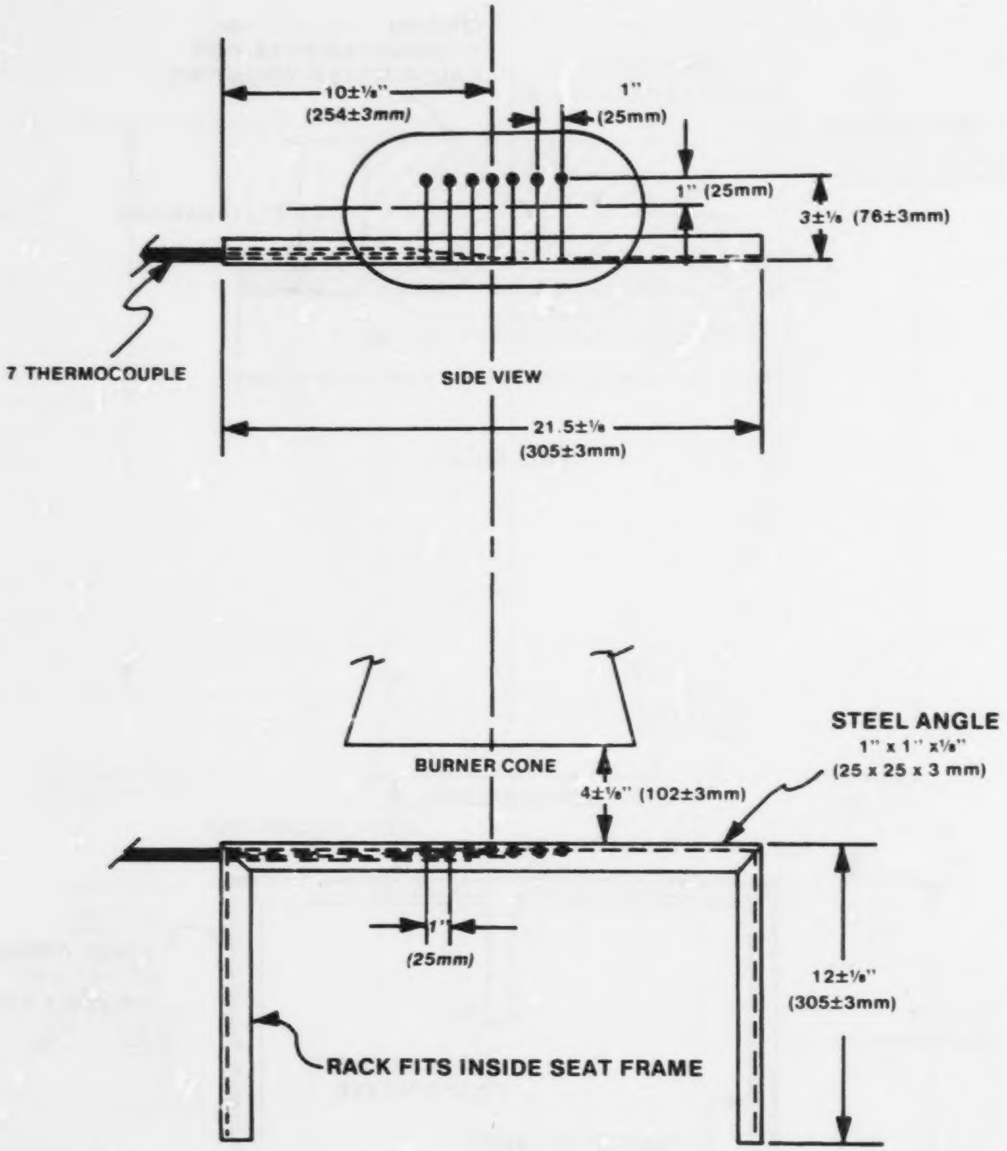

(25 mm)
1" DIAMETER HOLE FOR
CALORIMETER MOUNTING
(254±3mm)
10±1/8
(152 x 305 x 19 mm)
6" x 12" x 3/4"
MARINITE BLOCK
6±1/8" (152±3mm)
3±1/8
(76±3mm)
12±1/8" (305±3 mm)
21.5±1/8" (546±3 mm)
SIDE VIEW
BURNER CONE
(19 mm)
3/4"
4±1/8 (102±3 mm)
(25 mm) 1"DIAMETR
STEEL ANGLE
1" x 1" x 1/8"
(25 x 25 x 3 mm)
12±1/8
(305±3 mm)
WATER-COOLED
CALORIMETER
RACK FITS INSIDE
SEAT FRAME

TOP VIEW
CALORIMETER BRACKET

FIGURE 4

]

[


10±⅛"
(254±3mm)
1"
(25mm)
1" (25mm)
3±⅛ (76±3mm)
7 THERMOCOUPLE
SIDE VIEW
21.5±⅛
(305±3mm)
BURNER CONE
4±⅛" (102±3mm)
STEEL ANGLE
1" x 1" x⅛"
(25 x 25 x 3 mm)
1"
(25mm)
12±⅛"
(305±3mm)
RACK FITS INSIDE SEAT FRAME

TOP VIEW
THERMOCOUPLE RAKE BRACKET

FIGURE 5

]

Appendix F

[Part III—Test Method to Determine Flame Penetration Resistance of Cargo Compartment Liners

[(a) *Criteria for Acceptance.*

(1) At least three specimens of cargo compartment sidewall or ceiling liner panels must be tested.

(2) Each specimen tested must stimulate the cargo compartment sidewall or ceiling liner panel, including any design features, such as joints, lamp assemblies, etc., the failure of which would affect the capability of the liner to safety contains a fire.

(3) There must be no flame penetration of any specimen within 5 minutes after application of the flame source, and the peak temperature measured at 4 inches above the upper surface of the horizontal test sample must not exceed 400°F.

(b) *Summary of Method.* This method provides a laboratory test procedure for measuring the capability of cargo compartment lining materials to resist flame penetration with a 2 gallon per hour (GPH) #2 Grade kerosene or equivalent burner fire source. Ceiling and sidewall liner panels may be tested individually provided a baffle is used to simulate the missing panel. Any specimen that passes the test as a ceiling liner panel may be used as a sidewall liner panel.

(c) *Test Specimens.*

(1) The specimen to be tested must measure 16 ± $^1/_8$ inches (406 ± 3 mm) by 24 ± $^1/_8$ inches (610 ± 3 mm).

(2) The specimens must be conditioned at 70°F. ± 5°F. (21°C. ± 2°C.) and 55% ± 5% humidity for at least 24 hours before testing.

(d) *Test Apparatus.* The arrangement of the test apparatus, which is shown in Figure 3 of Part II and Figures 1 through 3 of this Part of Appendix F, must include the components described in this section. Minor details of the apparatus may vary, depending on the model of the burner used.

(1) *Specimen Mounting Stand.* The mounting stand for the test specimens consists of steel angles as shown in Figure 1.

(2) *Test Burner.* The burner to be used in testing must—

(i) Be a modified gun type.

(ii) Use a suitable nozzle and maintain fuel pressure to yield a 2 GPH fuel flow. For example: an 80 degree nozzle nominally rated at 2.25 GPH and operated at 85 pounds per square inch (PSI) gage to deliver 2.03 GPH.

(iii) Have a 12 inch (305 mm) burner extension installed at the end of the draft tube with an opening 6 inches (152 mm) high and 11 inches (280 mm) wide as shown in Figure 3 of Part II of this Appendix.

(iv) Have a burner fuel pressure regulator that is adjusted to deliver a nominal 2.0 GPH of #2 Grade kerosene or equivalent.

Burner models which have been used successfully in testing are the Lenox Model OB-32, Carlin Model 200 CRD and Park Model DPL. The basic burner is described in FAA Powerplant Engineering Report No. 3A, Standard Fire Test Apparatus and Procedures for Flexible Hose Assemblies, dated March 1978; however, the test settings specified in this Appendix differ in some instances from those specified in the report.

(3) *Calorimeter.*

(i) The calorimeter to be used in testing must be a total heat flux Foil Type Gardon Gage of an appropriate range (approximately 0 to 15.0 British thermal unit (BTU) per ft.^{2} sec., 0-17.0 watts/cm^2). The calorimeter must be mounted in a 6 inch by 12 inch]

[(152 by 305 mm) by ¾ inch (19 mm) thick insulating block which is attached to a steel angle bracket for placement in the test stand during burner calibration as shown in Figure 2 of this Part of this Appendix.

(ii) The insulating block must be monitored for deterioration and the mounting shimmed as necessary to ensure that the calorimeter face is parallel to the exit plane of the test burner cone.

(4) *Thermocouples.* The seven thermocouples to be used for testing must be $^1/_{16}$ inch ceramic sheathed, type K, grounded thermocouples with a nominal 30 American wire gage (AWG) size conductor. The seven thermocouples must be attached to a steel angle bracket to form a thermocouple rake for placement in the stand during burner calibration as shown in Figure 3 of this Part of this Appendix.

(5) *Apparatus Arrangement.* The test burner must be mounted on a suitable stand to position the exit of the burner cone a distance of 8 inches from the ceiling liner panel and 2 inches from the sidewall liner panel. The burner stand should have the capability of allowing the burner to be swung away from the test specimen during warm-up periods.

(6) *Instrumentation.* A recording potentiometer or other suitable instrument with an appropriate range must be used to measure and record the outputs of the calorimeter and the thermocouples.

(7) *Timing Device.* A stopwatch or other device must be used to measure the time of flame application and the time of flame penetration, if it occurs.

(e) *Preparation of Apparatus.* Before calibration, all equipment must be turned on and allowed to stabilize, and the burner fuel flow must be adjusted as specified in paragraph (d)(2).

(f) *Calibration.* To ensure the proper thermal output of the burner the following test must be made:

(1) Remove the burner extension from the end of the draft tube. Turn on the blower portion of the burner without turning the fuel or igniters on. Measure the air velocity using a hot wire anemometer in the center of the draft tube across the face of the opening. Adjust the damper such that the air velocity is in the range of 1550 to 1800 ft./min. If tabs are being used at the exit of the draft tube, they must be removed prior to this measurement. Reinstall the draft tube extension cone.

(2) Place the calorimeter on the test stand as shown in Figure 2 at a distance of 8 inches (203 mm) from the exit of the burner cone to simulate the position of the horizontal test specimen.

(3) Turn on the burner, allow it to run for 2 minutes for warm-up, and adjust the damper to produce a calorimeter reading of 8.0 ± 0.5 BTU per ft.^{2} sec. (9.1 ± 0.6 Watts/cm^2).

(4) Replace the calorimeter with the thermocouples rake (see Figure 3).

(5) Turn on the burner and ensure that each of the seven thermocouples reads 1700°F. ± 100°F. (927°C. ± 38°C.) to ensure steady state conditions have been achieved. If the temperature is out of this range, repeat steps 2 through 5 until proper readings are obtained.

(6) Turn off the burner and remove the thermocouple rake.

(7) Repeat (1) to ensure that the burner is in the correct range.

(g) *Test Procedure.*

(1) Mount a thermocouple of the same type as that used for calibration at a distance of 4 inches (101 mm) above the horizontal (ceiling) test specimen. The thermocouple should be centered over the burner cone.

(2) Mount the test specimen on the test stand shown in Figure 1 in either the horizontal or vertical position. Mount the insulating material in the other position.

(3) Position the burner so that flames will not impinge on the specimen, turn the burner on, and allow it to run for 2 minutes. Rotate the burner to apply the flame to the specimen and simultaneously start the timing device.

(4) Expose the test specimen to the flame for 5 minutes and then turn off the burner.]

[The test may be terminated earlier if flame penetration is observed.

(5) When testing ceiling liner panels, record the peak temperature measured 4 inches above the sample.

(6) Record the time at which flame penetration occurs if applicable .

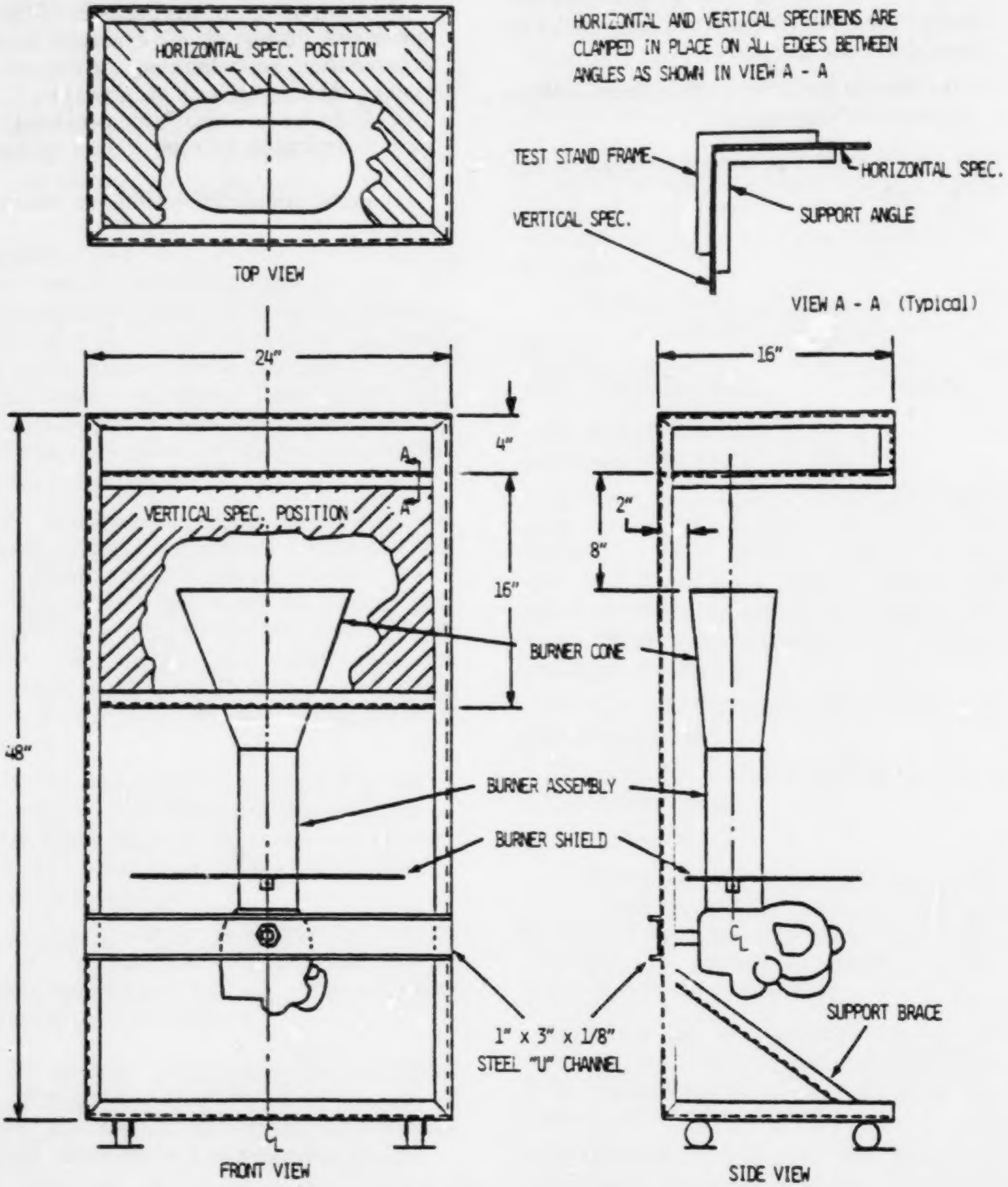
(h) *Test Report.* The test report must include the following:

(1) A complete description of the materials tested including type, manufacturer, thickness, and other appropriate data.

(2) Observations of the behavior of the test specimens during flame exposure such as delamination, resin ignition, smoke, etc., including the time of such occurrence.

(3) The time at which flame penetration occurs, if applicable, for each of three specimens tested.

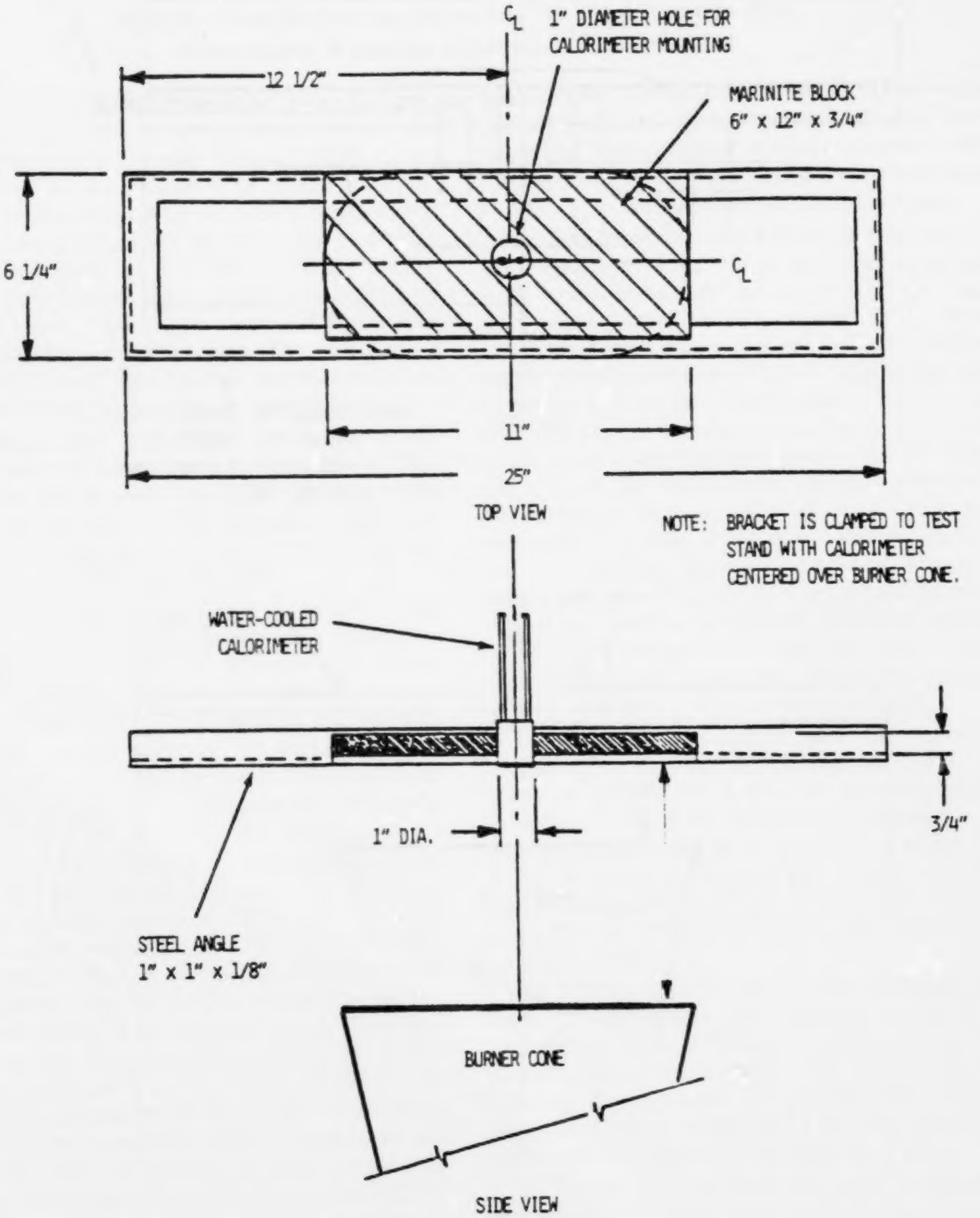
(4) Panel orientation (ceiling or sidewall).]


HORIZONTAL SPEC. POSITION
TOP VIEW
HORIZONTAL AND VERTICAL SPECIMENS ARE CLAMPED IN PLACE ON ALL EDGES BETWEEN ANGLES AS SHOWN IN VIEW A - A
TEST STAND FRAME
HORIZONTAL SPEC.
VERTICAL SPEC.
SUPPORT ANGLE
VIEW A - A (Typical)
24"
16"
4"
A
A
VERTICAL SPEC. POSITION
2"
8"
16"
48"
BURNER CONE
BURNER ASSEMBLY
BURNER SHIELD
1" x 3" x 1/8" STEEL "U" CHANNEL
SUPPORT BRACE
C_L
C_L
FRONT VIEW
SIDE VIEW

TEST STAND IS CONSTRUCTED WITH 1" x 1" x 1/8" STEEL ANGLES, ALL JOINTS WELDED
SUPPORT ANGLES ARE 1" x 1" x 1/8" CUT TO FIT

FIGURE 1. TEST APPARATUS FOR HORIZONTAL AND VERTICAL MOUNTING

[

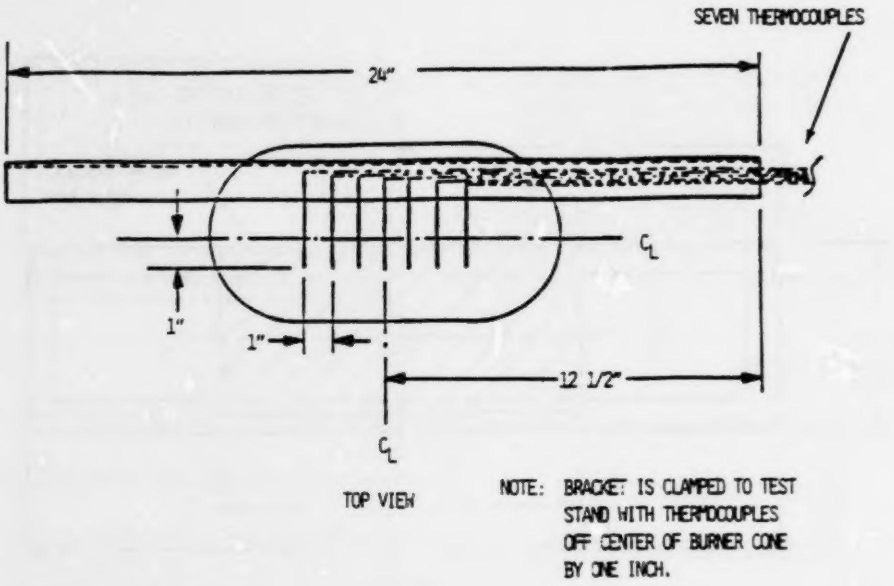


℄
1" DIAMETER HOLE FOR CALORIMETER MOUNTING
12 1/2"
MARINITE BLOCK 6" x 12" x 3/4"
6 1/4"
℄
11"
25"
TOP VIEW
NOTE: BRACKET IS CLAMPED TO TEST STAND WITH CALORIMETER CENTERED OVER BURNER CONE.
WATER-COOLED CALORIMETER
3/4"
1" DIA.
STEEL ANGLE 1" x 1" x 1/8"
BURNER CONE
SIDE VIEW

FIGURE 2. CALORIMETER BRACKET

]

[


SEVEN THERMOCOUPLES
24"
1"
1"
12 1/2"
℄
℄
TOP VIEW
NOTE: BRACKET IS CLAMPED TO TEST STAND WITH THERMOCOUPLES OFF CENTER OF BURNER CONE BY ONE INCH.

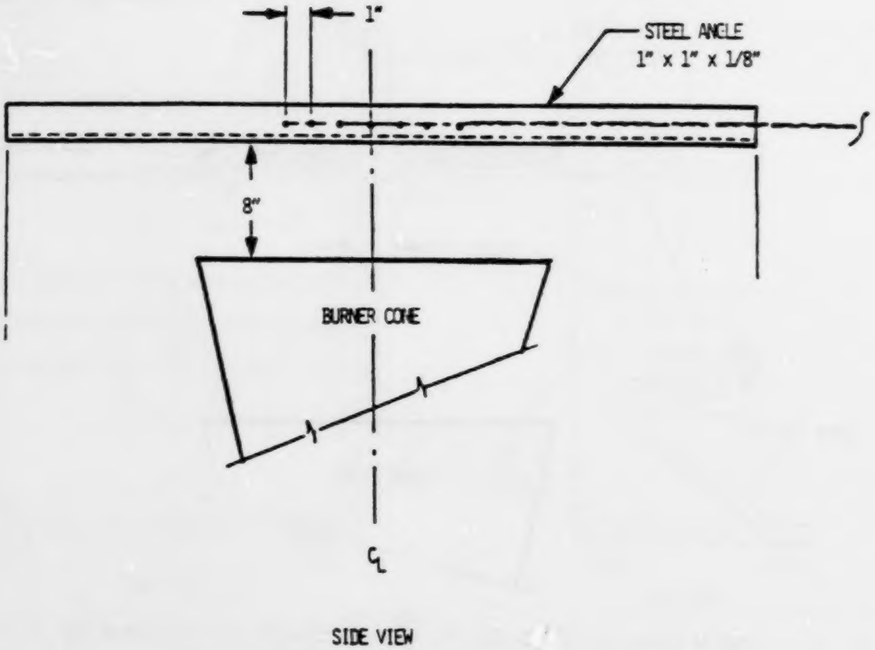

1"
STEEL ANGLE 1" x 1" x 1/8"
8"
BURNER CONE
℄
SIDE VIEW

FIGURE 3. THERMOCOUPLE RAKE BRACKET

]

Appendix F

Part IV—Test Method to Determine the Heat Release Rate From Cabin Materials Exposed to Radiant Heat

(a) *Summary of Method.*

(1) The specimen to be tested is injected into an environmental chamber through which a constant flow of air passes. The specimen's exposure is determined by a radiant heat source adjusted to produce the desired total heat flux on the specimen of 3.5 W/cm^2, using a calibrated calorimeter. The specimen is tested so that the exposed surface is vertical. Combustion is initiated by piloted ignition. The combustion products leaving the chamber are monitored in order to calculate the release rate of heat.

(b) *Apparatus.* The Ohio State University (OSU) rate of heat release apparatus as described below, is used. This is a modified version of the rate of heat release apparatus standardized by the American Society of Testing and Materials (ASTM), ASTM E-906.

(1) This apparatus is shown in Figure 1. All exterior surfaces of the apparatus, except the holding chamber, shall be insulated with 25mm thick, low density, high-temperature, fiberglass board insulation. A gasketed door through which the sample injection rod slides forms an airtight closure on the specimen hold chamber.

(2) *Thermopile.* [The temperature difference between the air entering the environmental chamber and that leaving is monitored by a thermopile having five hot and five cold, 24 gauge Chromel-Alumel junctions. The hot junctions are spaced across the top of the exhaust stack, 10mm below the top of the chimney. One thermocouple is located in the geometric center, with the other four located 30mm from the center along the diagonal toward each of the corners (Figure 5). The cold junctions are located in the pan below the lower air distribution plate (see paragraph (b)(4)). Thermopile hot junctions must be cleared of soot deposits as needed to maintain the calibrated sensitivity.]

(i) *Thermal Inertia Compensator.* A compensator tab is made from 0.55mm stainless steel sheet, 10 by 20mm. An 800 length of 24 gauge Chromel-Alumel, glass insulated, duplex thermocouple wire is welded or silver soldered to the tab as shown in Figure 2, and the wire bent back so that it is flush against the metal surface.

(ii) The compensator tab must be mounted on the exhaust stack as shown in Figure 3 using a 6-32 round head machine screw, 12mm long. Add small (approximately 4.5mm O.D., 9mm O.D.) washers between the head of the machine screw and the compensator tab to give the best response to a square wave input. (One or two washers should be adequate.) The "sharpness" of the square wave can be increased by changing the ratio of the output from the thermopile and compensator thermocouple which is fed to the recorder. The ratio is changed by adjusting the 1-K ohm variable resistor (R_1) of the thermopile bleeder shown in Figure 4. When adjusting compensation, keep R_1 as small as possible. Adjustment of the compensator must be made during calibration (see paragraph (c)(1)) at a heat release rate of 7.0 plus or minus 0.5 kW.

(iii) Adjust the washers and the variable resistor (R_1) so that 90 percent of full scale response is obtained in 8 to 10 seconds. There must be no overshoot, as shown in Figure 5A. If an insufficient number of washers is added, or R_1 is too small, the output with square wave input will look like Figure 5B; if too many washers are added and R_1 is too large, the output will look like Figure 5A.

(iv) Subtract the output of the compensator from the thermopile. The junctions enclosed in the dotted circle of Figure 4 are kept at the same constant temperature by electrically insulating the junctions and placing them on the pipe carrying air to the manifold, then covering them and the pipe with thermal insulation.

(v) Thermopile hot junctions must be cleared of soot deposits on a daily basis during periods of testing.

(3) *Radiation Source.* [A radiant heat source for generating a flux up to 100 kW/m^2, using four silicon carbide elements, Type LL, 20 inches (50.8 cm) long by $^5/_8$ inch (1.54 cm) O.D., nominal resistance 1.4 ohms, is shown in Figures 2A and 2B. The silicon carbide elements are mounted in the stainless steel panel box by inserting them through 15.9 mm holes in 0.8 mm thick ceramic fiber board. Location of the holes in the pads and stainless steel cover plates are shown in Figure 2B. The diamond shaped mask of 24-gauge stainless steel is added to provide uniform heat flux over the area occupied by the 150 by 150 mm vertical sample.]

(4) *Air Distribution System.* The air entering the environmental chamber is distributed by a 6.3 mm thick aluminum plate having eight, No. 4 drill holes, 51 mm from sides on 102 mm centers, mounted at the base of the environmental chamber. A second plate of 18 gauge steel having 120, evenly spaced, No. 28 drill holes is mounted 150 mm above the aluminum plate. A well-regulated air supply is required. The air supply manifold at the base of the pyramidal section has 48, evenly spaced, No. 26 drill holes located 10 mm from the inner edge of the manifold so that 0.03 m^3/second of air flows between the pyramidal sections and 0.01 m^3/second flows through the enviromental chamber when total air flow to apparatus is controlled at 0.04 m^3/second.

(5) *Exhaust Stack.* An exhaust stack, 133 mm by 70 mm in cross section, and 254 mm long, fabricated from 28 gauge stainless steel, is mounted on the outlet of the pyramidal section. A 25 mm by 76 mm plate of 31 gauge stainless steel is centered inside the stack, perpendicular to the air flow, 75 mm above the base of the stack.

(6) [*Specimen Holders.* The 150 mm × 150 mm specimen is tested in a vertical orientation. The holder (Figure 3) is provided with a specimen holder frame, which touches the specimen (which is wrapped with aluminum foil as required by paragraph (d)(3) of this part) along only the 6 mm perimeter, and a "V" shaped spring to hold the assembly together. A detachable 12 mm × 12 mm × 150 mm drip pan and two .020-inch stainless steel wires (as shown in Figure 3) should be used for testing of materials prone to melting and dripping. The positioning of the spring and frame may be changed to accommodate different specimen thicknesses by inserting the retaining rod in different holes on the specimen holder.

[Since the radiation shield described in ASTM E-906 is not used, a guide pin is added to the injection mechanism. This fits into a slotted metal plate on the injection mechanism outside of the holding chamber and can be used to provide accurate positioning of the specimen face after injection. The front surface of the specimen shall be 100 mm from the closed radiation doors after injection.

[The speciman holder clips onto the mounted bracket (Figure 3). The mounting bracket is attached to the injection rod by three screws which pass through a wide area washer welded onto a ½-inch nut. The end of the injection rod is threaded to screw into the nut and a .020 inch thick wide area washer is held between two ½-inch nuts which are adjusted to tightly cover the hole in the radiation doors through which the injection rod or calibration calorimeter pass.

[(7) *Calorimeter.* A total-flux flush calorimeter must be mounted in the center of a ½-inch Kaowool "M" board inserted in the sample holder to measure the total heat flux. The calorimeter must have a view angle of 180 degrees and be calibrated for incident flux. The calorimeter calibration must be acceptable to the Administrator.

[(8) *Pilot-Flame Positions.* Pilot ignition of the specimen must be accomplished by simultaneously exposing the specimen to a lower pilot burner and an upper pilot burner, as described in paragraph (b)(8)(i) and (b)(8)(ii), respectively. The pilot burners must remain lighted for the entire 5-minute duration of the test.

[(i) *Lower Pilot Burner.* The pilot-flame tubing must be 6.3 mm O.D., 0.8 mm wall, stainless steel tubing. A mixture of 120 cm^3/min. of methane and 850 cm^3/min. of air must be fed to the lower pilot flame burner. The normal position of the end of the pilot burner tubing is 10 mm from and perpendicular to the exposed vertical surface of the specimen. The centerline at the outlet of the burner tubing must intersect the vertical centerline of the sample at a point 5 mm above the lower exposed edge of the specimen.]

(ii) *Upper Pilot Burner.* The pilot burner must be a straight length of 6.3 mm O.D., 0.8 mm wall, stainless steel tubing is 360 mm long. One end of the tubing shall be closed, and three No. 40 drill holes shall be drilled into the tubing, 60 mm apart, for gas ports, all radiating in the same direction. The first hole must be 5 mm from the closed end of the tubing. The tube is inserted into the environmental chamber through a 6.6 mm hole drilled 10 mm above the upper edge of the window frame. The tube is supported and positioned by an adjustable "Z" shaped support mounted outside the environmental chamber, above the viewing window. The tube is positioned above and 20 mm behind the exposed upper edge of the specimen. The middle hole must be in the vertical plane perpendicular to the exposed surface of the specimen which passes through its vertical centerline and must be pointed toward the radiation source. The gas supplied to the burner must be methane adjusted to produce flame lengths of 25 mm.

(c) *Calibration of Equipment.—(1) Heat Release Rate.* [A burner as shown in Figure 4 must be placed over the end of the lower pilot flame tubing using a gas tight connection. The flow of gas to the pilot flame must be at least 99 percent methane and must be accurately metered. Prior to usage, the wet test meter is properly leveled and filled with distilled water to the tip of the internal pointer while no gas is flowing. Ambient temperature and pressure of the water are based on the internal wet test meter temperature. A baseline flow rate of approximately 1 liter/min is set and increased to higher preset flows of 4, 6, 8, 6, and 4 liters/min. The rate is determined by using a stopwatch to time a complete revolution of the wet test meter for both the baseline and higher flow, with the flow returned to baseline before changing to the next higher flow. The thermopile baseline voltage is measured. The gas flow to the burner must be increased to the higher preset flow and allowed to burn for 2.0 minutes, and the thermopile voltage must be measured. The sequence is repeated until all five values have been determined. The average of the five values must be used as the calibration factor. The procedure must be repeated if the percent relative standard deviation is greater than 5 percent. Calculations are shown in paragraph (f).]

(2) *Flux Uniformity.* Uniformity of flux over the specimen must be checked periodically and after each heating element change to determine if it is within acceptable limits of plus or minus 5 percent.

(d) *Sample Preparation.*

(1) [The standard size for vertically mounted specimens is 150 × 150 mm with thicknesses up to 45 mm.]

(2) *Conditioning.* Specimens must be conditioned as decribed in Part 1 of this Appendix.

(3) *Mounting.* Only one surface of a specimen will be exposed during a test. A single layer of 0.025 mm aluminum foil is wrapped tightly on all unexposed sides.

(e) *Procedure.* (1) The power supply to the radiant panel is set to produce a radiant flux of 3.5 W/cm². The flux is measured at the point which the center of the specimen surface will occupy when positioned for test. The radiant flux is measured after the air flow through the equipment is adjusted to the desired rate. The sample should be tested in its end use thickness.

(2) The pilot flames are lighted and their position, as described in paragraph (b)(8), is checked.

(3) The air flow to the equipment is set at 0.04 plus or minus 0.001 m^3/s at atmospheric pressure. Proper air flow may be set and monitored by either: (1) An orfice meter designed to produce a pressure drop of at least 200 mm of the manometric fluid, or by (2) a rotometer (variable orfice meter) with a scale capable of being read to plus or minus 0.0004 m^3/s. The stop on the vertical specimen holder rod is adjusted so that the exposed surface of the specimen is positioned 100 mm from the entrance when injected into the environmental chamber.

(4) The specimen is placed in the hold chamber with the radiation doors closed. The airtight outer door is secured, and the recording devices are started. The specimen must be retained in the hold chamber for 60 seconds, plus or minus 10 seconds, before injection. The thermopile "zero" value is determined during the last 20 seconds of the hold period.

(5) When the specimen is to be injected, the radiation doors are opened, the specimen is injected into the environmental chamber, and the radiation doors are closed behind the specimen.

(6) [Reserved.]

(7) [Injection of the specimen and closure of the inner door marks time zero. A record of the thermopile output with at least one data point per second must be made during the time the specimen is in the environmental chamber.]

(8) The test duration time is five minutes.

(9) A minimum of three specimens must be tested.

(f) *Calculations.* (1) The calibration factor is calculated as follows:

$$k_h = \frac{(F_1 - F_0)}{(V_1 - V_0)} \times \frac{(210.8-22)k_{cal}}{mole} \times \frac{273}{T_a} \times \frac{P-P_v}{760} \quad \frac{mole\ CH4STP}{22.41} \times \frac{WATT.\ min}{.01433kcal} \times \frac{kw}{1000w}$$

F_0 = flow of methane at baseline (1pm)
F_1 = higher preset flow of methane (1pm)
V_0 = thermopile voltage at baseline (mv)
V_1 = Thermopile voltage at higher flow (mv)
T_a = Ambient temperature (K)
P = Ambient pressure (mm Hg)
P_v = Water vapor pressure (mm Hg)

(2) [Heat release rates may be calculated from the reading of the thermopile output voltage at any instant of time as:

$$HRR = \frac{(V_m \times K_h}{.02323\ m^2}$$

HRR = Heat release Rate kw/m^2
V_m = measured thermopile voltage (mv)
K_h = Calibration Factor (Kw/mv)]

(3) The integral of the heat release rate is the total heat release as a function of time and is calculated by multiplying the rate by the data sampling frequency in minutes and summing the time from zero to two minutes.

(g) *Criteria.* The total positive heat release over the first two minutes of exposure for each of the three or more samples tested must be averaged, and the peak heat release rate for each of the samples must be averaged. The average total heat release must not exceed 65 kilowatt-minutes per square meter, and the average peak heat release rate must not exceed 65 kilowatts per square meter.

(h) *Report.* The test report must include the following for each specimen tested:

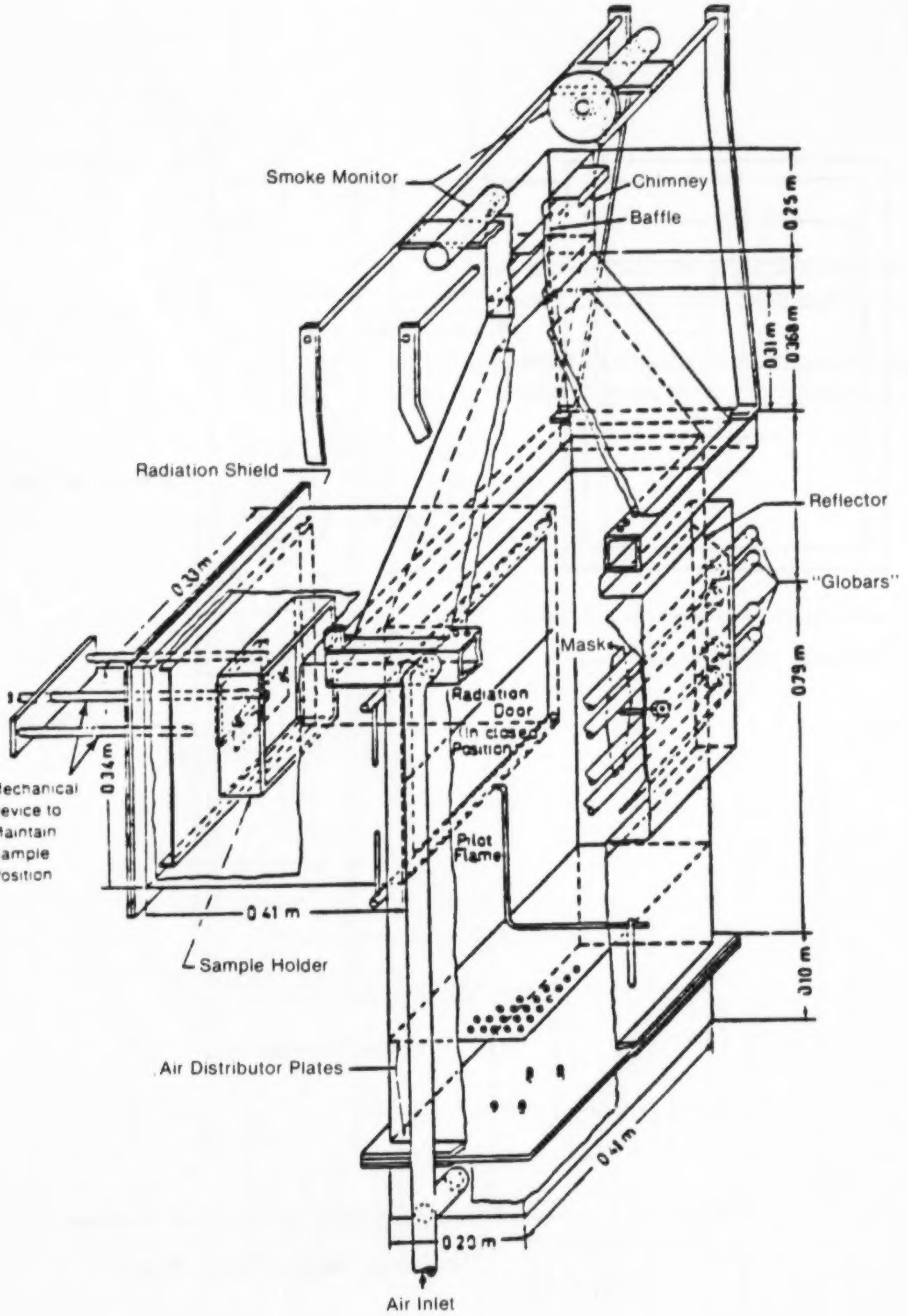
(1) Description of the specimen.

(2) Radiant heat flux to the specimen, expressed in W/cm^2.

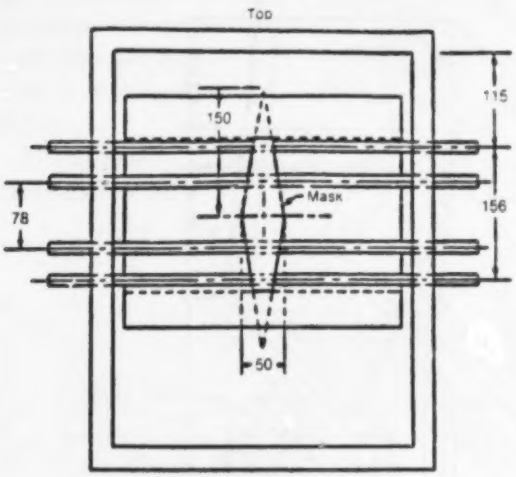
(3) Data giving release rates of heat (in kW/m2) as a function of time, either graphically or tabulated at intervals no greater than 10 seconds. The calibration factor (k_h) must be recorded.

(4) If melting, sagging, delaminating, or other behavior that affects the exposed surface area or the mode of burning occurs, these behaviors must be reported, together with the time at which such behaviors were observed.

(5) The peak heat release and the 2 minute integrated heat release rate must be reported.

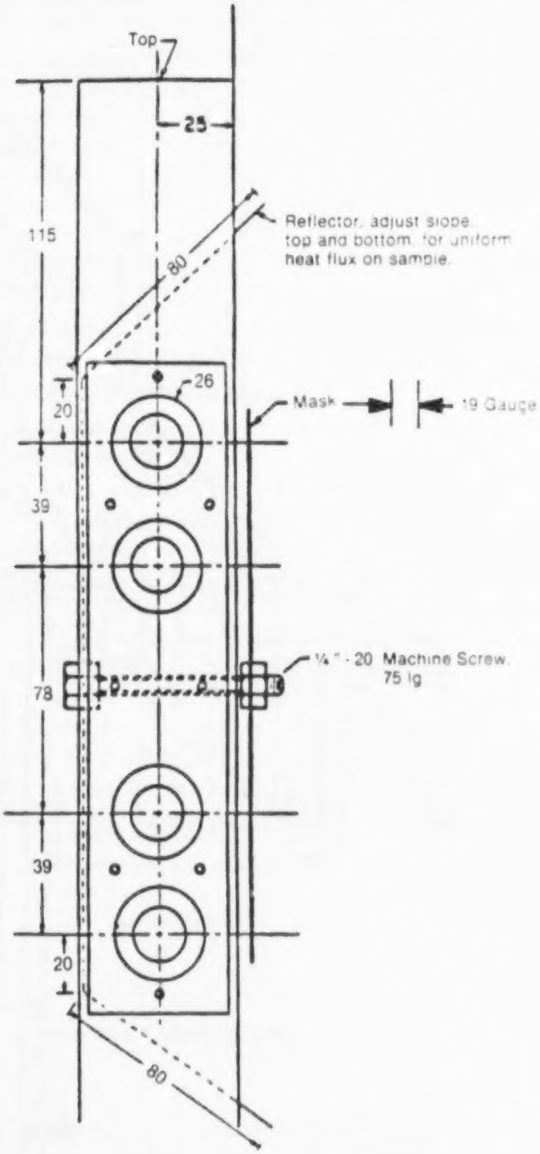

Smoke Monitor
Chimney
Baffle
0.25 m
0.31 m
0.368 m
Radiation Shield
Reflector
"Globars"
0.30 m
Mask
0.79 m
Radiation Door (In closed Position)
0.34 m
Mechanical Device to Maintain Sample Position
Pilot Flame
0.41 m
Sample Holder
0.10 m
Air Distributor Plates
0.41 m
0.20 m
Air Inlet

[Figure 1. Release Rate Apparatus]


Top
115
150
Mask
78
156
50

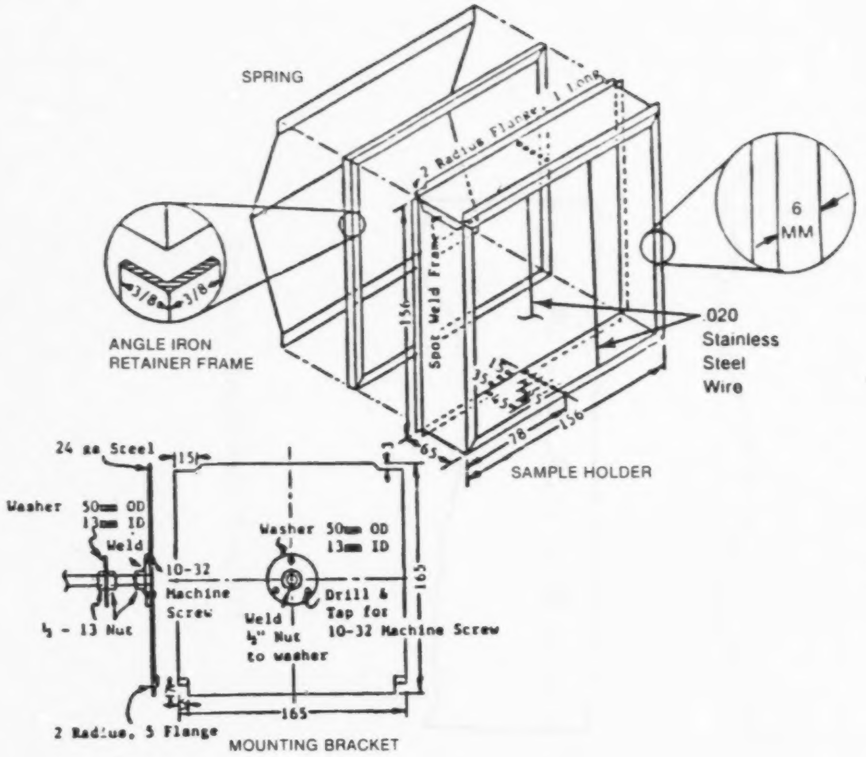
(Unless denoted otherwise all dimensions are in milimeters.)

[Figure 2A. "Globar" Radiant Panel]


Top
25
Reflector, adjust slope, top and bottom, for uniform heat flux on sample.
115
80
20
26
Mask
19 Gauge
39
¼" - 20 Machine Screw, 75 lg
78
39
20
80

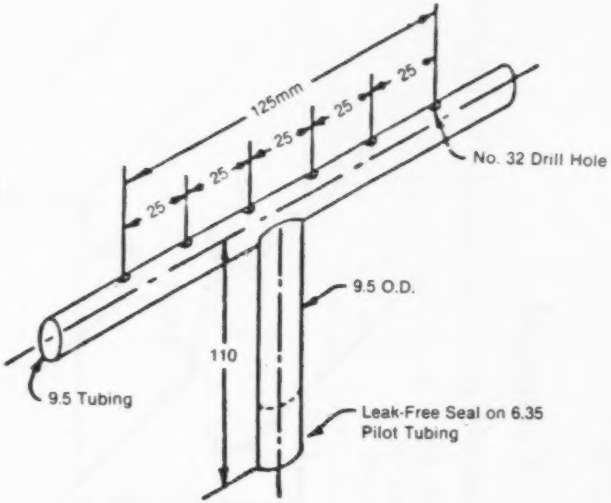
(Unless denoted otherwise all dimensions are in milimeters.)

[Figure 2B. "Globar" Radiant Panel]


SPRING
2 Radius Flange, 1 Long
ANGLE IRON RETAINER FRAME
3/8
3/8
156
Spot Weld Frame
6 MM
.020 Stainless Steel Wire
15
35
5
5
65
78
156
SAMPLE HOLDER
24 ga Steel
15
Washer 50mm OD 13mm ID
Weld
10-32 Machine Screw
½ - 13 Nut
Washer 50mm OD 13mm ID
Weld ½" Nut to washer
Drill & Tap for 10-32 Machine Screw
165
165
2 Radius, 5 Flange
MOUNTING BRACKET

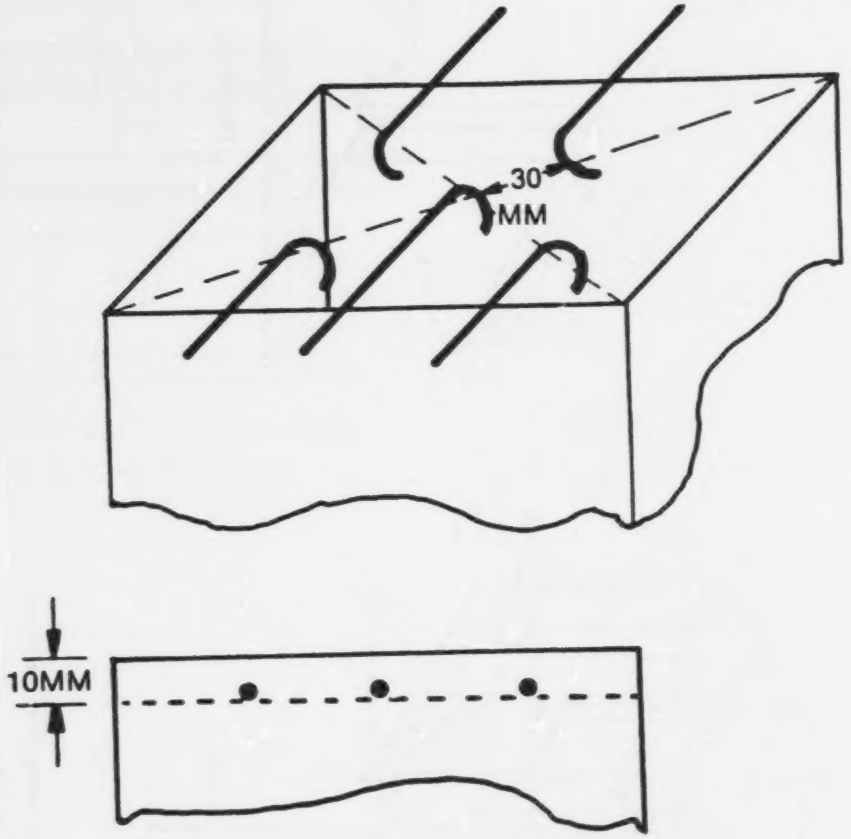
(Unless denoted otherwise, all dimensions are in millimeters.)

[Figure 3.]


125mm
25
25
25
25
25
No. 32 Drill Hole
9.5 O.D.
110
9.5 Tubing
Leak-Free Seal on 6.35 Pilot Tubing

(Unless denoted otherwise, all dimensions are in millimeters.)

[Figure 4.]



[Figure 5. Thermocouple Position]

[Appendix F

[Part V—Test Method to Determine the Smoke Emission Characteristics of Cabin Materials

[(a) *Summary of Method.* The specimens must be constructed, conditioned, and tested in the flaming mode in accordance with American Society of Testing and Materials (ASTM) Standard Test Method ASTM F814-83.

[(b) *Acceptance Criteria.* The specific optical smoke density (D_s), which is obtained by averaging the reading obtained after 4 minutes with each of the three specimens, shall not exceed 200.]

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Appendix G

Continuous Gust Design Criteria

The continuous gust design criteria in this appendix must be used in establishing the dynamic response of the airplane to vertical and lateral continuous turbulences unless a more rational criteria is used. The following gust load requirements apply to mission analysis and design envelope analysis:

(a) The limit gust loads utilizing the continuous turbulence concept must be determined in accordance with the provisions of either paragraph (b) or paragraphs (c) and (d) of this appendix.

(b) *Design envelope analysis.* The limit loads must be determined in accordance with the following:

(1) All critical altitudes, weights, and weight distributions, as specified in § 25.321(b), and all critical speeds within the ranges indicated in paragraph (b) (3) of this appendix must be considered.

(2) Values of $\bar{A}$ (ratio of root-mean-square incremental load root-mean-square gust velocity) must be determined by dynamic analysis. The power spectral density of the atmospheric turbulence must be as given by the equation—

ART WORK—EQUATION

where:

ϕ=power-spectral density (ft./sec.)^2/rad./ft.

β=root-mean-square gust velocity, ft./sec.

Ω=reduced frequency, radians per foot.

L=2,500 ft.

(3) The limit loads must be obtained by multiplying the $\bar{A}$ values determined by the dynamic analysis by the following values of the gust velocity $U\sigma$:

(i) At speed V_C: $U\sigma=85$ fps true gust velocity in the internal 0 to 30,000 ft. altitude and is linearly decreased to 30 fps true gust velocity at 80,000 ft. altitude. Where the Administrator finds that a design is comparable to a similar design with extensive satisfactory service experience, it will be acceptable to select $U\sigma$ at V_C less than 85 fps, but not less than 75 fps, with linear decrease from that value at 20,000 feet to 30 fps at 80,000 feet. The following factors will be taken into account when assessing comparability to a similar design:

(1) The transfer function of the new design should exhibit no unusual characteristics as compared to the similar design which will significantly affect response to turbulence; e.g., coalescence of modal response in the frequency regime which can result in a significant increase of loads.

(2) The typical mission of the new airplane is substantially equivalent to that of the similar design.

(3) The similar design should demonstrate the adequacy of the $U\sigma$ selected.

(ii) At speed V_B: $U\sigma$ is equal to 1.32 times the values obtained under paragraph (b)(3)(i) of this appendix.

(iii) At speed V_D: $U\sigma$ is equal to ½ the values obtained under paragraph (b)(3)(i) of this appendix.

(iv) At speeds between V_B and V_C and between V_C and V_D: $U\sigma$ is equal to a value obtained by linear interpolation.

(4) When a stability augmentation system is included in the analysis, the effect of system nonlinearities on loads at the limit

load level must be realistically or conservatively accounted for.

(c) *Mission analysis.* Limit loads must be determined in accordance with the following:

(1) The expected utilization of the airplane must be represented by one or more flight profiles in which the load distribution and the variation with time of speed, altitude, gross weight, and center of gravity position are defined. These profiles must be divided into mission segments or blocks, for analysis, and average or effective values of the pertinent parameters defined for each segment.

(2) For each of the mission segments defined under paragraph (c)(1) of this appendix, values of $\bar{A}$ and N_0 must be determined by analysis. $\bar{A}$ is defined as the ratio of root-mean-square incremental load to root-mean-square gust velocity and N_0 is the radius of gyration of the load power spectral density function about zero frequency. The power spectral density of the atmospheric turbulence must be given by the equation set forth in paragraph (b)(2) of this appendix.

(3) For each of the load and stress quantities selected, the frequency of exceedance must be determined as a function of load level by means of the equation—

ART WORK—EQUATION

where—

t = selected time interval.

y = net value of the load or stress.

Y_{one-g} = value of the load or stress in one-g level flight.

N(y) = average number of exceedances of the indicated value of the load or stress in unit time.

Σ = symbol denoting summation over all mission segments.

$N_0, \bar{A}$ = parameters determined by dynamic analysis as defined in paragraph (c)(2) of this appendix.

P_1, P_2, b_1, b_2, = parameters defining the probability distributions of root-mean-square gust velocity, to be read from Figures 1 and 2 of this appendix.

The limit gust loads must be read from the frequency of exceedance curves at a frequency of exceedance of 2×10^{-5} exceedances per hour. Both positive and negative load directions must be considered in determining the limit loads.

(4) If a stability augmentation system is utilized to reduce the gust loads, consideration must be given to the fraction of flight time that the system may be inoperative. The flight profiles of paragraph (c)(1) of this appendix must include flight with the system inoperative for this fraction of the flight time. When a stability augmentation system is included in the analysis, the effect of system nonlinearities on loads at the limit load level must be conservatively accounted for.

(d) *Supplementary design envelope analysis.* In addition to the limit loads defined by paragraph (c) of this appendix, limit loads must also be determined in accordance with paragraph (b) of this appendix, except that—

(1) In paragraph (b)(3)(i) of this appendix, the value of $U\sigma = 85$ fps true gust velocity is replaced by $U\sigma = 60$ fps true gust velocity on the interval 0 to 30,000 ft. altitude, and is, linearly decreased to 25 fps true gust velocity at 80,000 ft. altitude; and

(2) In paragraph (b) of this appendix, the reference to paragraphs (b)(3)(i) through (b)(3)(iii) of this appendix is to be understood as referring to the paragraph as modified by paragraph (d)(1).

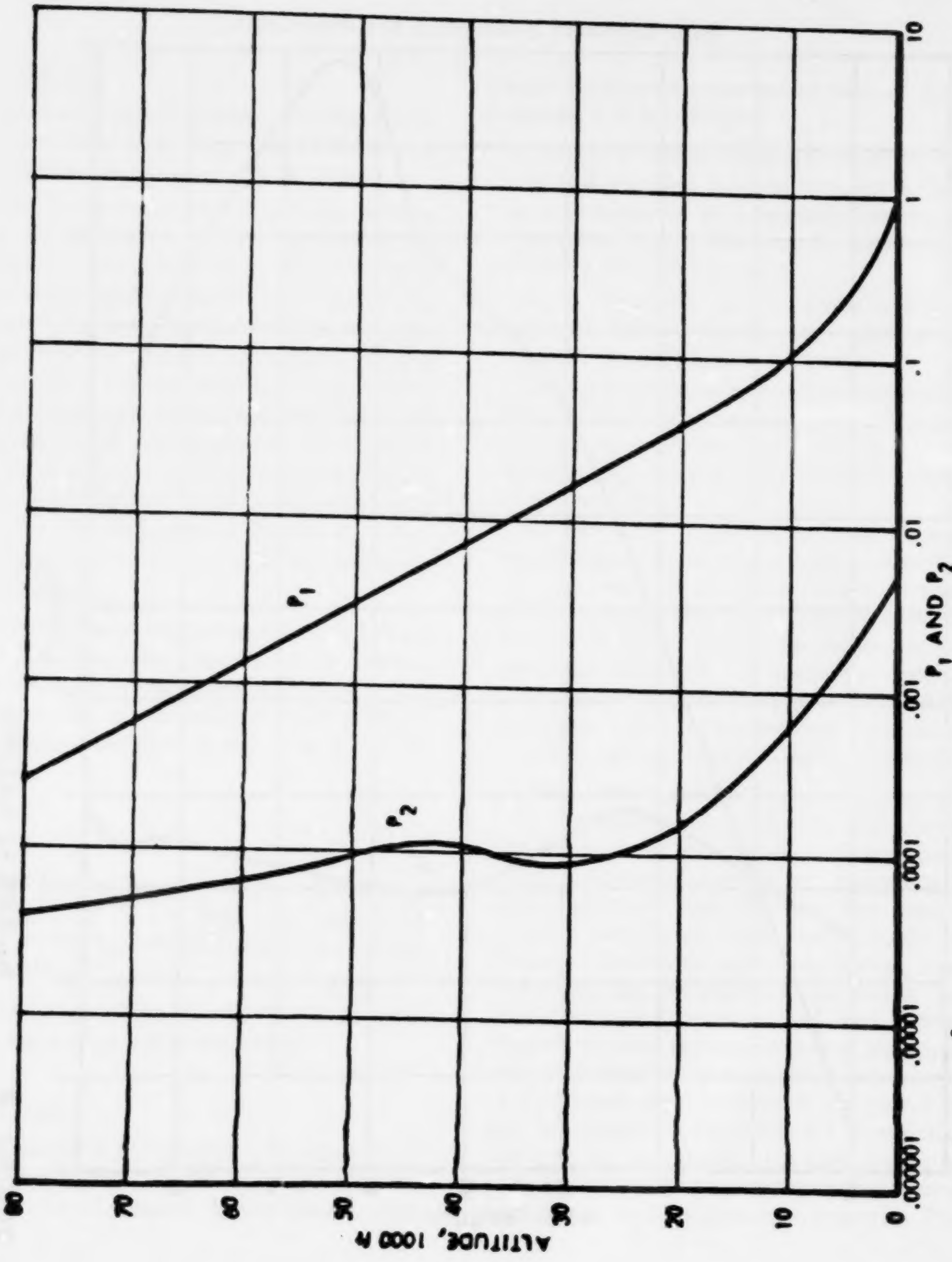


FIGURE 1 P_1 AND P_2 VALUES

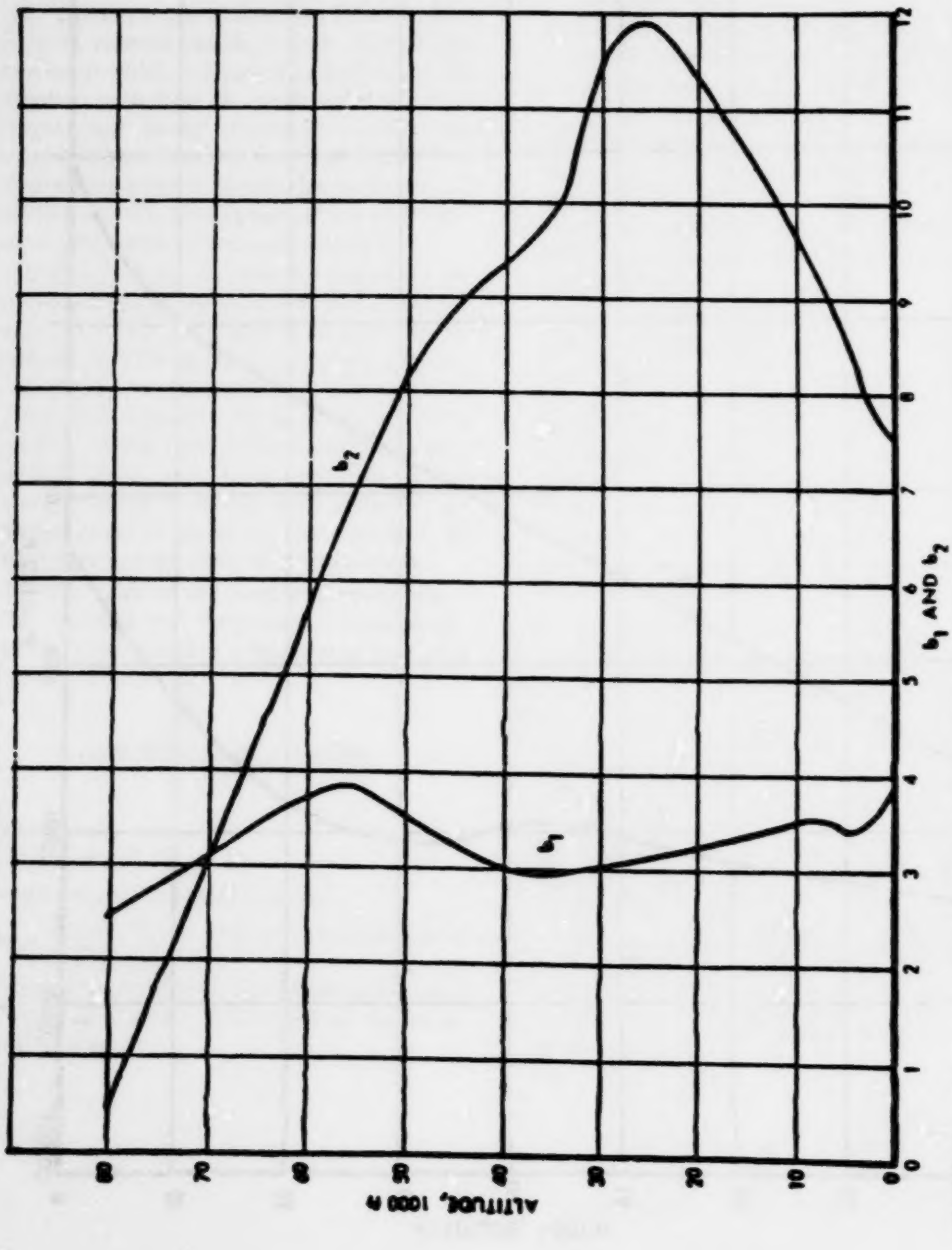


FIGURE 2 b_1 AND b_2 VALUES

Appendix H

Instructions For Continued Airworthiness

H25.1 *General.*

(a) This Appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by § 25.1529.

(b) The Instructions for Continued Airworthiness for each airplane must include the Instructions for Continued Airworthiness for each engine and propeller (hereinafter designated 'products'), for each appliance required by this chapter, and any required information relating to the interface of those appliances and products with the airplane. If Instructions for Continued Airworthiness are not supplied by the manufacturer of an appliance or product installed in the airplane, the Instructions for Continued Airworthiness for the airplane must include the information essential to the continued airworthiness of the airplane.

(c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of products and appliances installed in the airplane will be distributed.

H25.2 *Format.*

(a) The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.

(b) The format of the manual or manuals must provide for a practical arrangement.

H25.3 *Content.*

The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information:

(a) *Airplane maintenance manual or section.*

(1) Introduction information that includes an explanation of the airplane's features and data to the extent necessary for maintenance or preventive maintenance.

(2) A description of the airplane and its systems and installations including its engines, propellers, and appliances.

(3) Basic control and operation information describing how the airplane components and systems are controlled and how they operate, including any special procedures and limitations that apply.

(4) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, location of access panels for inspection and servicing, locations of lubrication points, lubricants to be used, equipment required for servicing, tow instructions and limitations, mooring, jacking, and leveling information.

(b) *Maintenance Instructions.*

(1) Scheduling information for each part of the airplane and its engines, auxiliary power units, propellers, accessories, instruments, and equipment that provides the recommended periods at which they should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection, the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The

recommended overhaul periods and necessary cross references to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the airplane.

(2) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.

(3) Information describing the order and method of removing and replacing products and parts with any necessary precautions to be taken.

(4) Other general procedural instructions including procedures for system testing during ground running, symmetry checks, weighing and determining the center of gravity, lifting and shoring, and storage limitations.

(c) Diagrams of structural access plates and information needed to gain access for inspections when access plates are not provided.

(d) Details for the application of special inspection techniques including radiographic and ultrasonic testing where such processes are specified.

(e) Information needed to apply protective treatments to the structure after inspection.

(f) All data relative to structural fasteners such as identification, discard recommendations, and torque values.

(g) A list of special tools needed.

H25.4 *Airworthiness Limitations section.*

The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure approved under § 25.571. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads: "The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§ 43.16 and 91.163 of the Federal Aviation Regulations unless an alternative program has been FAA approved."

[Appendix I

[Installation of an Automatic Takeoff Thrust Control System (ATTCS)

[I25.1 General.

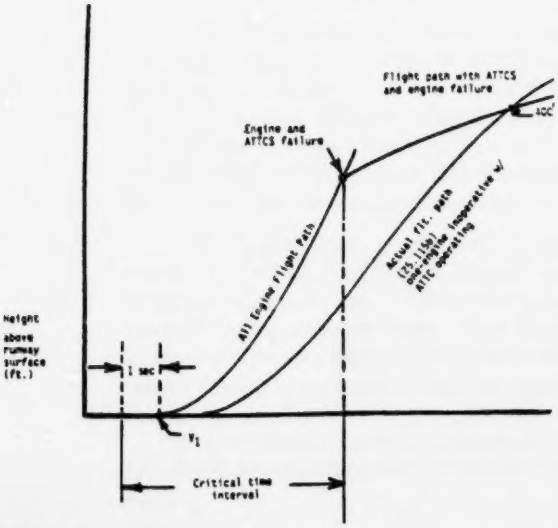
(a) This appendix specifies additional requirements for installation of an engine power control system that automatically resets thrust or power on operating engine(s) in the event of any one engine failure during takeoff.

(b) With the ATTCS and associated systems functioning normally as designed, all applicable requirements of Part 25, except as provided in this appendix, must be met without requiring any action by the crew to increase thrust or power.

[I25.2 Definitions.

(a) *Automatic Takeoff Thrust Control System (ATTCS).* An ATTCS is defined as the entire automatic system used on takeoff, including all devices, both mechanical and electrical, that sense engine failure, transmit signals, actuate fuel controls or power levers or increase engine power by other means on operating engines to achieve scheduled thrust or power increases, and furnish cockpit information on system operation.

(b) *Critical Time Interval.* When conducting an ATTCS takeoff, the critical time interval is between V_I minus 1 second and a point on the minimum performance, all-engine flight path where, assuming a simultaneous occurrence of an engine and ATTCS failure, the resulting minimum flight path thereafter intersects the Part 25 required actual flight path at no less than 400 feet above the takeoff surface. This time interval is shown in the following illustration:



[I25.3 Performance and System Reliability Requirements.

The applicant must comply with the performance and ATTCS reliability requirements as follows:

(a) An ATTCS failure or a combination of failures in the ATTCS during the critical time interval:

(1) Shall not prevent the insertion of the *maximum approved takeoff* thrust or power, or must be shown to be an improbable event.

(2) Shall not result in a significant loss or reduction in thrust or power, or must be shown to be an extremely improbable event.

(b) The concurrent existence of an ATTCS failure and an engine failure during the critical time interval must be shown to be extremely improbable.

(c) All applicable performance requirements of Part 25 must be met with an engine failure occurring at the most critical point during takeoff with the ATTCS system functioning.

[I25.4 Thrust Setting.

The initial takeoff thrust or power setting on each engine at the beginning of the takeoff roll may not be less than any of the following:

(a) Ninety (90) percent of the thrust or power set by the ATTCS (the maximum takeoff thrust or power approved for the airplane under existing ambient conditions);

(b) That required to permit normal operation of all safety-related systems and equipment dependent upon engine thrust or power lever position; or

(c) That shown to be free of hazardous engine response characteristics when thrust or power is advanced from the initial takeoff thrust or power to the maximum approved takeoff thrust or power.

[I25.5 Powerplant Controls.

(a) In addition to the requirements of § 25.1141, no single failure or malfunction, or probable combination thereof, of the ATTCS, including associated systems, may cause the failure of any powerplant function necessary for safety.

(b) The ATTCS must be designed to:

(1) Apply thrust or power on the operating engine(s), following any one engine failure during takeoff, to achieve the maximum approved takeoff thrust or power without exceeding engine operating limits;

(2) Permit manual decrease or increase in thrust or power up to the maximum takeoff thrust or power approved for the airplane under existing conditions through the use of the power lever. For airplanes equipped with limiters that automatically prevent engine operating limits from being exceeded under existing ambient conditions, other means may be used to increase the thrust or power in the event of an ATTCS failure provided the means is located on or forward of the power levers; is easily identified and operated under all operating conditions by a single action of either pilot with the hand that is normally used to actuate the power levers; and meets the requirements of § 25.777(a), (b), and (c);

(3) Provide a means to verify to the flightcrew before takeoff that the ATTCS is in a condition to operate; and

(4) Provide a means for the flightcrew to deactivate the automatic function. This means must be designed to prevent inadvertent deactivation.

[I25.6 Powerplant Instruments.

In addition to the requirements of § 25.1305:

(a) A means must be provided to indicate when the ATTCS is in the armed or ready condition; and

(b) If the inherent flight characteristics of the airplane do not provide adequate warning that an engine has failed, a warning system that is independent of the ATTCS must be provided to give the pilot a clear warning of any engine failure during takeoff.]

Special Federal Aviation Regulation 13

(SFAR 13)

(Effective September 10, 1954)

1. Applicability. Contrary provisions of the Civil Air Regulations regarding certification notwithstanding,* this regulation shall provide the basis for approval by the Administrator of modifications of individual Douglas DC-3 and Lockheed L-18 airplanes subsequent to the effective date of this regulation.

2. General modifications. Except as modified in sections 3 and 4 of this regulation, an applicant for approval of modifications to a DC-3 or L-18 airplane which result in changes in design or in changes to approved limitations shall show that the modifications were accomplished in accordance with the rules of either Part 4a or Part 4b in effect on September 1, 1953, which are applicable to the modification being made: *Provided,* That an applicant may elect to accomplish a modification in accordance with the rules of Part 4b in effect on the date of application for the modification in lieu of Part 4a or Part 4b as in effect on September 1, 1953: *And provided further,* That each specific modification must be accomplished in accordance with all of the provisions contained in the elected rules relating to the particular modification.

3. Specific conditions for approval. An applicant for any approval of the following specific changes shall comply with section 2 of this regulation as modified by the applicable provisions of this section:

(a) *Increase in takeoff power limitation—1,200 to 1,350 horsepower.* The engine takeoff power limitation for the airplane may be increased to more than 1,200 horsepower but not to more than 1,350 horsepower per engine if the increase in power does not adversely affect the flight characteristics of the airplane.

(b) *Increase in takeoff power limitation to more than 1,350 horsepower.* The engine takeoff power limitation for the airplane may be increased to more than 1,350 horsepower per engine if compliance is shown with the flight characteristics and ground handling requirements of Part 4b.

(c) *Installation of engines of not more than 1,830 cubic inches displacement and not having a certificated takeoff rating of more than 1,350 horsepower.* Engines of not more than 1,830 cubic inches displacement and not having a certificated takeoff rating of more than 1,350 horsepower which necessitate a major modification or redesign of the engine installation may be installed, if the engine fire prevention and fire protection are equivalent to that on the prior engine installation.

(d) *Installation of engines of more than 1,830 cubic inches displacement or having certificated takeoff rating of more than 1,350 horsepower.* Engines of more than 1,830 cubic inches displacement or having certificated takeoff rating of more than 1,350 horsepower may be installed if compliance is shown with the engine installation requirements of Part 4b: *Provided,* That where literal compliance with the engine installation requirements of Part 4b is extremely difficult to accomplish and would not contribute materially to the objective sought, and the Administrator finds that the experience with the DC-3 or L-18 airplanes justifies it, he is authorized to accept such measures of compliance as he finds will effectively accomplish the basic objective.

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* It is not intended to waive compliance with such airworthiness requirements as are included in the operating parts of the Civil Air Regulations for specific types of operation.

4. Establishment of new maximum certificated weights. An applicant for approval of new maximum certificated weights shall apply for an amendment of the airworthiness certificate of the airplane and shall show that the weights sought have been established, and the appropriate manual material obtained, as provided in this section. (Note: Transport category performance requirements result in the establishment of maximum certificated weights for various altitudes.)

(a) *Weights—25,200 to 26,900 for the DC-3 and 18,500 to 19,500 for the L-18.* New maximum certificated weights of more than 25,200 but not more than 26,900 pounds for DC-3 and more than 18,500 but not more than 19,500 pounds for L-18 airplanes may be established in accordance with the transport category performance requirements of either Part 4a or Part 4b, if the airplane at the new maximum weights can meet the structural requirements of the elected part.

(b) *Weights of more than 26,900 for the DC-3 and 19,500 for the L-18.* New maximum certificated weights of more than 26,900 pounds for DC-3 and 19,500 pounds for L-18 airplanes shall be established in accordance with the structural, performance, flight characteristics, and ground handling requirements of Part 4b: *Provided,* That where literal compliance with the structural requirements of Part 4b is extremely difficult to accomplish and would not contribute materially to the objective sought, and the Administrator finds that the experience with the DC-3 or L-18 airplane justifies it, he is authorized to accept such measures of compliance as he finds will effectively accomplish the basic objective.

(c) *Airplane flight manual—performance operating information.* An approved airplane flight manual shall be provided for each DC-3 and L-18 airplane which has had new maximum certificated weights established under this section. The airplane flight manual shall contain the applicable performance information prescribed in that part of the regulations under which the new certificated weights were established and such additional information as may be necessary to enable the application of the takeoff, en route, and landing limitations prescribed for transport category airplanes in the operating parts of the Civil Air Regulations.

(d) *Performance operating limitations.* Each airplane for which new maximum certificated weights are established in accordance with paragraphs (a) or (b) of this section shall be considered a transport category airplane for the purpose of complying with the performance operating limitations applicable to the operations in which it is utilized.

5. Reference. Unless otherwise provided, all references in this regulation to Part 4a and Part 4b are those parts of the Civil Air Regulations in effect on September 1, 1953.

This regulation supersedes Special Civil Air Regulation SR-398 and shall remain effective until superseded or rescinded by the Board.

[19 F.R. 5039, Aug. 11, 1954. Redesignated at 29 F.R. 19099, Dec. 30, 1964]

*U. S. GOVERNMENT PRINTING OFFICE:1989-241-686:07012